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THE TRADE OF THE UNITED STATES.

THE Foreign Office report on the trade of the United States for the year ending June 30th, 1902, drawn up by Mr. Bell, British Commercial Agent, is a document of absorbing interest. It illustrates with extraordinary precision the industrial position of affairs in that country as it exists at the present time. But it also shows how absolutely unable even the best informed authority is to foresee what shall be the effect on other nations, if further progress in development at a rate which the world has never before witnessed, continues without a severe check. During the past fiscal year the total value of the exports from the States were $104,980,945 less than in the preceding period; but although $65,000,000 of this decrease was due to a failure in the Indian corn crop, a fall in exports of nearly $40,000,000 is left. The iron and steel goods exported were worth only $98,552,562 in 1901-02, as against $117,319,320 in 1900-01; on the other hand, the corresponding imports rose from $17,874,789 to $27,180,255. These figures do not indicate any lack of prosperity in the iron and steel trades; they mean simply that the home industries, notably the railways, are growing at such a speed that the iron-masters are unable to keep pace with the local consumption. Instead of trying now to conquer the world's markets, as so many writers have been expecting them to do, the manufacturers of the States are devoting all their attention to their own country, developing their sources of coal and ore, multiplying the capacity of their plants, taking control of the railways and other transport agencies, and generally getting everything into readiness against the time when, in the face of severe competition, they may have to deliver goods at any spot on the surface of the globe.

Unless some internal cataclysm occurs, then, the day is not far distant when the facilities for producing all varieties of raw and manufactured products at extremely low prices will overtake and exceed the dimensions of the home markets; and then by some means or other the Americans must and will find some foreign outlets for their goods. It is, of course, by no means certain that this day will arrive, or, at any rate, that it will be so disastrous to the European when it does arrive as now appears probable, for there are not wanting symptoms of unrest in the States. In the past, labour has fought and won, or has been freely granted, increase of wages, although those increases have not been equivalent to the smaller purchasing power of money; and so long as the men find steady employment year in year out they are fairly content. If, however, future competition abroad, or the action of domestic trusts, should cut prices till wages can no longer be raised or maintained at their present level, there may be an outbreak of strikes which will upset the calculations of all the millionaires. Mr. Bell says a good word for Trusts, or, rather, for the

United States Steel Corporation, because that body has refused to raise prices unduly. It would be well for all such combinations to act similarly if they desire to justify their existence; but it must be remembered that as both capital and labour are now combining on a scale of unparalleled magnitude, the first serious labour war in the States will also be of unparalleled magnitude, and will assuredly "stagger humanity."

In the meantime, we of Great Britain can only be thankful for the postponement of the forthcoming struggle—it is our clear duty to assume that it is forthcoming. We have had plenty of warning of what we may expect, from Americans as well as from our representatives abroad, and we shall have no one to blame if we are still unprepared to meet it. Without blindly following the American lead and adopting devices unsuited to the conditions obtaining in this country, there are numerous lessons to be learnt from America, and many other things can be done to strengthen our position. Firstly, we may suggest a step in the direction of education, viz., that both our employers and our employés (or their trade unions) need to be taught how uneconomical a machine the human being is for the performance of visible work. The function of a man is to use his intelligence, and the bulk of the growing population requires to be educated till it has one. The employer must lay down machine tools and mechanical apparatus wherever possible, in order that he may reduce his wages bill—not reducing his wages *per capita*, but lowering them per unit of material turned out. And the workman must be taught that while he is justified in demanding a fair day's wage for a fair day's work, he must honestly "put in" a fair day's work for his fair day's wage. The principle of the sliding scale in wages might be made more general, but while employers must be ready, without external pressure, to grant (or rather give) a slide up, the workman must be equally ready, when the occasion arises, to accept a slide down—which apparently is a new and wholly distasteful idea to him. Moreover, the process must be carried further; each man must be permitted by his union, and encouraged by his employer, to work his hardest, and his recompense must be commensurate with that of his output, not measured by the value of the laziest loafer in the shop.

Another lesson of enormous importance must be learnt without delay by our railway magnates and similar authorities. In the States either the railways and shipping firms strive their utmost to assist every budding industry by working for the minimum of profit, and by avoiding vexatious restrictions, or they are bought up by the manufacturing trusts. The last operation is not free from disadvantage, and is entirely foreign to British notions; but a hint may be given to our carrying agencies that the nation cannot permit the heavy industries of the country to be unfairly handicapped for the sake of the shareholders in over-capitalised and somnolent transporting concerns.

Railways and Electric Tramways.

How far is a municipality justified in setting up a rate-aided competition with its own ratepayers? This point has frequently cropped up in different parts of the country, and it is bound to come more prominently forward in proportion to the progress of the principles of municipal trading. It is an injustice—as reprehensible as it is palpable—that companies and traders who are compelled to pay a large and increasing portion of the public rates, should be placed in that humiliating position where their own contributions are utilised to compete with them in the very business which enables them to pay those rates. In the electric wiring, fittings, and contracting industries, municipal competition has been fought against in the Parliamentary Committee room in the past with some success, but our electric contracting associations will do well to be prepared to continue their very laudable efforts to meet fresh onslaughts. A matter which is more in the public mind at the present moment is the peculiar position in which railway companies are being placed by the existence of electric trolley tramlines owned by municipal corporations. We have no particular affection for the railway companies of this country as at present managed, but we cannot help allowing them a sympathetic corner in our heart when we find them paying many thousands of pounds per annum to those who are themselves engaged competitively in a business which is destined to aim a very powerful blow at their undertaking. We are wholly at one with those who urge that these railway companies ought to save themselves by electrifying their suburban lines. We believe that several of the electric tramway and light railway systems which have been successful would not have shown such good results but for the existence of a bad suburban steam railway service; but, be that as it may, the fact remains that the railway companies are helping the very service which is ruining their local and suburban traffic. The existence of this state of affairs was brought out very strongly by the chairmen of the different railway companies at their half-yearly meetings, but it has received additional emphasis from the recently-announced decision of the Glasgow and South-Western Railway Company to withdraw its suburban service to Govan and Springburn, with the exception of its workmen's trains—which, presumably, it is compelled to continue under its Parliamentary powers. The sole reason for this remarkable decision is found in the electric tramways competition at cheaper fares by a municipality which, of course, has the public thoroughfares at its disposal, and has, comparatively speaking, but nominal expense to bear in connection therewith. We are not in possession of the full facts of the position, but it looks as though the railway company has given in too willingly. We read that the service from St. Enoch Station to Govan was withdrawn temporarily three years ago, but was re-instituted last year. It is also stated that the company carried 250,000 fewer passengers in the last half-year, and of this reduction nearly 200,000 was due to the falling off in suburban traffic. However this may be, we must confess that we should have thought better of it if it had again withdrawn its service, but only for a period sufficient to enable it to provide an electrified local service, or at any rate, if it had shown more of a fighting disposition. There is a chance, however, that the present course may be deliberately adopted as a temporary expedient, so as to bring home more forcefully than hitherto the unfair position in which railways are now being placed. Or it may even be that railway men are coming to believe that the local railway service is to be more or less permanently superseded by the trolley line along the public highways. Whichever view they hold, the position is certainly interesting. The North-Eastern electrification scheme is fresh in the minds of our readers, and it is also well known that the railways competing with the West London electric trams have had to adopt great improvements with a view to recovering lost traffic. If it is possible to form any conclusion from the situation as we see it at present, it is this, that our railway

companies have no more time to waste in *considering* whether to convert their suburban services to electric traction. They must *act*. And this remark is especially applicable to London, where the electric tramway will shortly be a far more powerful rival than it is at present. But after all there is the unfairness of the competition, which calls for rectification somehow.

Scientific Literature in England and Germany.

GERMANY leads the world in scientific research, and it is therefore perhaps natural that hand-books on various branches of theoretical and technical science should multiply more rapidly in that country than in our own.

When one compares the scientific publications of recent years in the two countries, one is struck, however, by the wide gap that separates the English and German text-books. The majority of the former deal with elementary science, and are designed for the preparation of students for some particular examination. A large proportion of them are written by ambitious teachers, whose qualifications to be considered an authority on the particular science, are based on a London Science Degree or upon a South Kensington "Honours" Pass. In this type of text-book our supremacy is undoubted and unassailable. The German publications, on the other hand, in most cases pre-suppose an acquaintance with the elementary facts of the science with which they deal, and are intended for experts, or for those who wish to become experts, in the various branches of study.

The latest example of this difference in the scientific publications of the two countries, is the announcement of a series of monographs—on applied electro-chemistry—by the well-known German firm of Wilhelm Knapp, of Halle. The first and second of these volumes dealing with the electrolytic production of oxygen and hydrogen and the extraction of aluminium, have already appeared. In this country we have barely arrived at the point of recognising electro-chemistry as a special branch of scientific study, and only one University has yet appointed a special lecturer on the subject. The elementary text-book on Electro-chemistry, designed for cramming students for a South Kensington "pass," has yet to appear; but possibly some diligent science school teacher is even now preparing it for publication. In Germany most of the Universities have been equipped for some years with laboratories for electro-chemical work, and special Professors or Lecturers for this branch of physical science have been appointed. A large number of students have taken up electro-chemistry as a special study, and useful research work has been carried out by these men when working for their Ph.D. degree.

An educated public has therefore to some extent been created in Germany, to whom the present series of hand-books will appeal, and as some of these monographs will no doubt be translated and reproduced in Paris, London and New York, the venture may prove a financial success for the firm which has been bold enough to undertake it. Whether successful or the reverse, the publication of a series of German hand-books on applied electro-chemistry, is a proof not only that our Teutonic cousins have more faith in the future of this branch of applied science than we ourselves, but also that their system of education is better fitted than our own for following up and developing new branches of scientific study.

Electric Power Supply at Sunderland.

IN our "Electric Lighting Notes" last week was given an outline of a very important scheme which has been taken in hand by the Sunderland Corporation to more adequately meet the demand of the district, especially the numerous establishments connected with the great shipbuilding and repairing industries, for electric power supply. It is most essential that everything reasonable should be done to encourage the application of electric power in all branches of industry, and the very practical and interesting paper by Mr. D. Selby Bigge, which is now being published in our columns, will be perused, we think, with satisfaction by our readers. The Sunderland Corporation by its adoption of the excellent scheme planned by its chief electrical engineer (Mr. Snell), would appear to be more enlightened than the municipal authorities of many other large cities. Where the supply of electricity is in the hands of a municipality, the authority has been told by Parliament that unless proper facilities are provided, competition from power or other companies must be expected. No doubt it is partly to prevent such competition that Sunderland is taking action. Leaving out of mind for the moment the "municipal trading" arguments which may be advanced against such schemes, we must confess to certain feelings of satisfaction that at least one municipality is alive to its responsibilities and is to encourage electric power development, and that, from an engineering standpoint, is the most important part of the matter.

The Science of the Workshop.—In a paper on this subject read by Mr. William Taylor, of Leicester, before the British Association at Belfast, it is complained that technical schools do but teach more or less backward shop practice, so that the workman out of the shop cannot really improve his knowledge or practice by attending a school. Yet there is a science of the workshop. Its material is scattered in books and papers, and much is known to men of experience, but the author knows of no attempt to gather such knowledge into more attainable form. The teaching of the shop has been all wrong. The schools cannot teach methods, but have tried to do so, and have failed. What they should teach is principles, as embodied in the physical properties of materials and their effect on cutting and shaping, stresses generally, photo-micrography, alloys, the flow of solids; these are all examples of the science which underlies shop work. How little, for example, is known of tool steel by most shop men! How blind we have all been to the action of superheated steam on cast-iron. Look at the failures to make a satisfactory boiler stay-tap, the money lost in striving to secure an even contraction of the hardened tap. Take the question of flow of metals. It is said that a milling cutter of 3 to 4 in. diameter with deep teeth on face and edges has actually been formed cold from a blank by hydraulic pressure. Time to allow of flow appears to be an element in all processes of rolling, extension pressing, &c., of metals, but there is no written matter to teach others. So many of the best shop men do not, or cannot, write; we use the word in its narrower sense. It is a pity it is so, for much valuable knowledge is lost for lack of the setting of it down, and too often when handed down by tradition the essentials become blurred and debased. Practice soon forgets scientific reasons, and loses its best part. The decadence of the workshop tends to keep out the better men, and shop work becomes set apart as a thing to be avoided. The science of tools and of materials can alone add something to the sordid life of the shop. There are so many half-known facts to be explained. Why will a saw that cuts steel break to pieces if set to cut copper? What limits or fixes the speed of various cutting or abrading agencies? Cannot our technical schools teach the principles that enable men to think out these matters? This is what they should attempt.

The St. Louis Exposition, 1904.—Mr. W. E. Goldsborough, chief of the "Electricity" Department in connection with this great undertaking, has placed before us a circular descriptive of the project more particularly relating to the "broad demonstration of the scientific and industrial developments in electricity" which will be made in the "Electricity" Building. This World's Fair is far more advantageously situated, both as regards available area and funds, than any previous exposition has been. Over 1,200 acres are already included in the Exposition tract, upon which upwards of $50,000,000 will be spent. Of this amount $20,000,000 is now available. A point especially worthy of note is the decision that no charges shall be made for space allotted for exhibits, and in addition to this the U.S. Treasury has provided for the free entry of all goods intended solely for exhibition. The officials are anxious to get to know names of firms who are prepared to exhibit, and the nature and extent of their exhibit, so that they may go into the question of allotting space as soon as possible. Perhaps our readers are aware that the exhibition is to commemorate the purchase of the Louisiana territory in 1803. The original arrangement was for the Fair to be held next year, but it has had to be postponed until 1904.

D

THE POLYCYCLIC DISTRIBUTION OF ELECTRICITY.

The polycyclic distribution of electricity consists in the transmission of electric currents of different periodicities and voltages over the same conductor. Let the resistance and self-induction of a conductor be respectively R and L, and let a current

$$c_1 = \sqrt{2}\, C_1 \sin \omega_1 t$$

flow through it. The E.M.F. necessary to force this current through the conductor is also a sine function of the time, and is equal to

$$e_1 = \sqrt{2}\, C_1 \sqrt{R^2 + \omega_1^2 L^2} \sin \left(\omega_1 t + \arctan \frac{\omega_1 L}{R} \right),$$

i.e., a sine function E.M.F. can only produce a sine function current of the same periodicity, and it follows that such an E.M.F. can only perform work with a sine current of the same frequency. Another current of a different periodicity flowing in the same conductor is quite independent of this one. The one current cannot perform work with the voltage of the other, and flows as if the other were not present. As the currents are independent one of the other, their effects and losses are to be directly added, so that they, as well as the currents, simply superimpose one upon each other.

The total ohmic losses are therefore

$$(C_1^2 + C_2^2)\, R = C^2 R.$$

It follows that the resulting effective current is

$$C = \sqrt{(C_1^2 + C_2^2)},$$

and the resulting E.M.F. is

$$E = \sqrt{(E_1^2 + E_2^2)},$$

and the total power

$$= W = E_1 C_1 \cos \phi_1 + E_2 C_2 \cos \phi_2.$$

There have been several attempts made to work out systems of distribution of electricity on the above basis. It is claimed by the originators that the systems offer several advantages, among which are the following:—

1. By the use of two periodicities it is possible to supply each customer with the periodicity which is the more suited to his requirements. Thus, if he wants current for lighting purposes, 50 periods (not under) will be supplied him, but should he want it for power, 25 periods will perhaps be the more suitable.

2. The connecting-up and installing of lighting plants, and the regulation of the lighting voltage, are greatly simplified.

3. The voltage and voltage drop in the feeders and distribution network for motors can both be made much bigger than if the same current be used for both lighting and power, as for lamps the voltage must be kept lower and more constant than for motors. By these means a considerable saving in copper can be made. It follows from these three points that the motors and generators may be made cheaper, as the wattless current, which the motors take, will be smaller, and, what is more, the wattless current will not matter, as the volt drop due to it may be bigger.

4. In an overhead transmission line with the same effective voltage between the wires, and the same percentage loss of power with a four or three-phase current of power 100, and a superimposed single-phase current of power 50, the copper required is only 66·7 of that required for a single-phase transmission of the same total power and the same conditions; this is a saving of 9 per cent. as compared with a simple three-phase system.

5. In a cable transmission line, with the same effective voltage between the wires and the same loss of watts, by means of a four-phase system with superimposed current, 23 per cent. more power can be transmitted than without the superimposed current, the superimposed current being one-half the main current. With three-phase systems 9 per cent. more power can be transmitted with superimposed current than without, when the power of the superimposed current is half that of the main current.

The above advantages are those specially claimed for the Arnold-Bragstad-la Cour system, upon which a lecture was recently given before the Elektrotechnischen Gesellschaft, of Frankfort-on-the-Maine, by Prof. E. Arnold, of Karlsruhe.* Some remarks as to the validity of these claims will be made later on, after a brief sketch of the details of polycyclic systems in general, and especially of that system worked out by the three above-named gentlemen.

(*a*) *Superimposing of Currents by Leading them in at Neutral Points.*—In the following (fig. 1) balanced three-

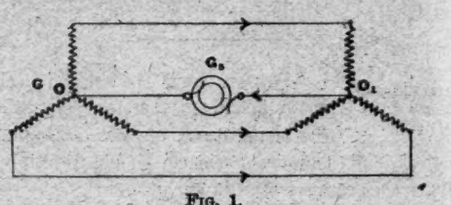


Fig. 1.

phase star system there is no difference of potential between the neutral points. It can, therefore, be regarded as one conductor for the transmission of a current between its neutral points as shown. The arrows show the direction of flow of the superimposed current, which can be of any periodicity, or a direct current.

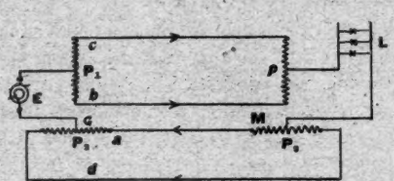


Fig. 2.

Fig. 2 shows the arrangement for a two-phase system with four conductors.

The arrows show the direction of flow of the superimposed current, and L denotes lamps connected between the neutral points of the two-phase motor.

On these principles rested the system worked out by Dr. Fr. Bedell (see Electrical Review, July 6th, 1900, pp. 16 and 32), which, however, has not been found capable of practical application by reason of the great inductive volt drop of the superimposed current in the generators and transformers of the main current.

Starting from this point the Arnold-Bragstad-la Cour system avoids this inductive drop by making all the windings non-inductive with respect to the superimposed current; such a winding is called a bifilar winding. For example, for putting in or taking out a superimposed current from a single-phase system, a choke coil can be used connected between the conductors.

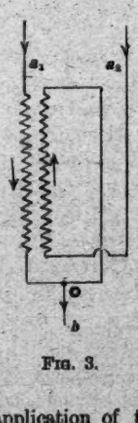


Fig. 3.

Fig. 3 shows the application of the bifilar principle to such a choke coil.

The arrows show the direction of flow of the superimposed current. It will be seen that the inductive effect of this current is zero, while the inductive effect of the main current is the sum of the inductive effects of the two parallel

* See *Elektrotechnische Zeitschrift*, 1902, Nos. 26 and 27.

coils wound on the same core. A secondary winding can, of course, be wound on this and used for the transformation of the main current.

Analogous arrangements can be made for three-phase systems and also in the winding of the single or polyphase motor or generator, so that the superimposed current can be taken out or introduced there.

(*b*) *Taking up and Giving out the Superimposed Current by means of Transformers.*—The inductive drop of Bedell's arrangement can also, besides the method of non-inductive windings as given above, be obviated by introducing the different currents not by simple conduction but by means of induction, *i.e.*, of superposition of magnetic fluxes in the same transformer. The advantage is also obtained by this method that the same transformer can be used for transforming both the superimposed and the main currents.

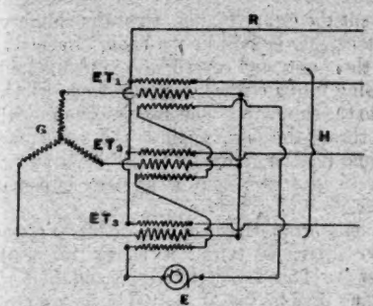


Fig. 4.

Fig. 4 shows the arrangement of three single-phase transformers serving as the main system for the three-phase current and for the concurrent taking in and transformation of a superimposed single-phase alternating current.

G is the three-phaser; E T_1, E T_2, E T_3, are the three single-phase transformers which have each two primary windings and one secondary winding. Three of these primary windings, one for each transformer, are connected in star and serve for the three-phase current, while the remaining primary windings are connected in series and serve for the single-phase alternating current generated in E. H represents the three conductors of the three-phase transmission line, and R is the return conductor of the superimposed alternating current.

(*c*) *Concurrent Transformation and Concurrent Generation of the Main Current and the Superimposed Current.*—Fig. 5 shows how such a transformation can be carried out in the

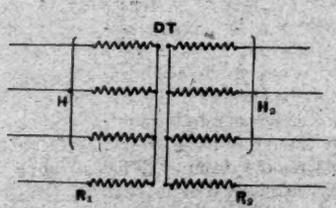


Fig. 5.

case where the main current is a three-phase current, and the superimposed current a single-phase current of different periodicity.

D T is a four-limbed three-phase transformer; H_1 and H_2 the primary and secondary of the main current, R_1 and R_2 the primary and secondary return leads of the superimposed current. R_1 and R_2 are wound round the return magnetic circuit of the transformer in the wished-for transformation ratio of the superimposed current.

In order to generate the two currents in the same armature windings, machines possessing a double system of poles (one beside the other) are proposed.

It is obvious that by a little ingenuity many systems of transmission and transformation, &c., may be worked out, and in the papers above referred to several more are given which cannot, however, be referred to here. We think, in fact, that the system cannot be regarded as a practical system of working, but rather as one capable of affording pretty blackboard illustrations for theoreticians and mental gymnastics (of course excellent in their way) for unfortunate technical students in racking their brains to find out where and where not the different superimposed currents will get to.

In spite of the advantages above set out, we are unable to see where the system could be profitably applied. As regards advantage No. 1, closer examination proves it to be practically an illusion. The advantages of 25 periods, as compared with 50 periods and higher, are:—

(*a*) Long-distance transmission more economical.

(*b*) Enables rotaries to be used instead of motor-generators for conversion to direct current.

If now a 50-period current be superimposed upon the 25-period current, advantage (*a*) is lost, as far as itself is concerned; and secondly, the 50-period current is not required, as (*b*) the lighting can be done by means of the direct current, as well as the power distribution. If the line be not a very long one, and rotaries be not used, then the advantages of 25 periods disappear, and with them also, if they existed at all, those of superimposed alternating current of 50 periods. There remains now to consider the superposition of direct current on an alternating current. Direct current is almost always at a low voltage. It would, however, never do to superimpose a low voltage direct current on a high voltage alternating current, as the extra cost of the insulation, due to the increased sectional area of the copper, would far and away outweigh any advantage gained. A low voltage distribution of alternating current with superimposed direct is an absurdity, as the motor load can best be borne by the direct current itself.

The alleged simplification of wiring, &c., resulting from this system is, in our opinion, also a fallacy. We think this must be clear to anybody, other than the originators themselves, who has tried to wend his way through the ramifications of the system. As an example, the determination of the right gauge for fuse wires in this system would be a matter of no small difficulty.

The saving in copper said to be theoretically possible is also doubtful; in any case, it is small, and depends for its attainment on the adjustment of the load of the main current and superimposed current and other things which would be hardly possible in practice. Among other practical details which have not received attention at the inventor's hands, and which would have to be got over, are the increased capital costs of the bifilar-wound choke coils, &c., necessary to the system (*i.e.*, one application of it), and the effects which would be brought about by the different phases of a polyphase system being out of balance. All things considered, we think there can be no fear that the polycyclic system of distribution of electrical energy will offer any serious competition with the standard methods in use to-day.

C. C. G.

REFUSE DESTRUCTION: ITS SANITARY AND STEAM-RAISING ASPECTS.

By FRANK BROADBENT, M.I.E.E.

(*Concluded from page* 336.)

VI.

Generally speaking, simplicity is conducive to efficiency; and the "Simplex" destructor forms no exception to, but strikingly confirms, this general rule. Some of the best results in Tables IV. and V. were obtained with this type of furnace.

The furnace is not divided up into cells, as is done in most other forms, but consists of one wide, continuous grate, fired from two, three, or four furnace mouths, according to width. From back to front the grates are usually about 5 ft. long, and a firing door is provided to each 5 ft. of

width; that is, the grate is divided up into sections of 25 sq. ft. The doors are counter-balanced, and are divided vertically, so that one-half can be lifted at a time for firing purposes, the other half shielding the fireman, and preventing too great an inrush of cold air.

The ashpits, below the fire-bars, are divided into air-tight sections, corresponding with the number of firing doors. Each ashpit is provided with two steam-jet blowers, having regulating hand-wheels in front, by means of which the forced draught may be controlled.

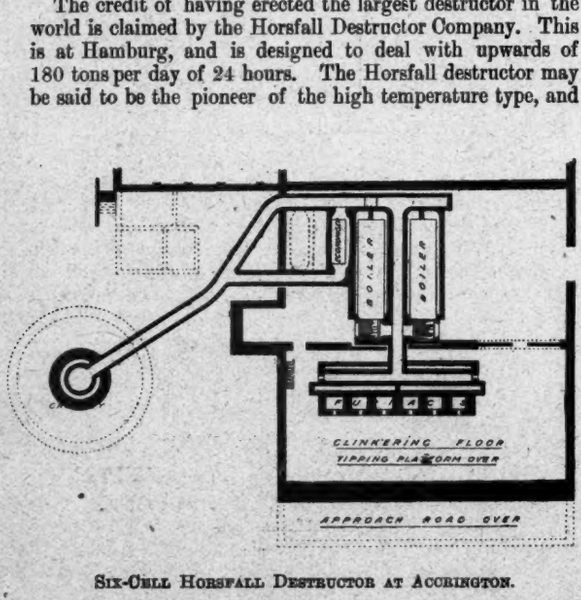
At one end of the grates a fire-bridge is built, over which the hot gases pass into a large combustion chamber. As the gases from the fire furthest from the bridge must pass over all the other fires, it is generally arranged that any wet refuse that has to be destroyed is fed on to this grate. A mattress chamber for infected bedding is often provided at this end also. The temperature in the combustion chamber ranges from 1,800° F. and upwards, and, with a four-grate destructor, an average of over 2,000° F. can be maintained. Most of the dust given off from the fires settles in the combustion chamber, from which it is easily removed periodically.

After leaving this chamber, the hot gases pass through the boiler and flues in the ordinary way. Owing to the high temperature of the gases, it is always advisable to use an economiser in conjunction with the boilers, so as to utilise as much of the heat as possible. To add still further to the efficiency of the system, the air for the forced draught is also heated by means of the waste gases. This is effected by means of what is called a "regenerator." The regenerator consists of a number of cast-iron tubes, arranged in parallel, through which the flue gases pass, and around which the cold air is drawn on its way to the furnaces, becoming heated by this means to a temperature of 300° F. to 350° F.

The quantity of steam used for the forced draught is about 15 per cent. of the amount generated, leaving 85 per cent. available for useful work.

Messrs. Meldrum Bros. also supply a "top feed" type of destructor, when the conditions favour this type.

The credit of having erected the largest destructor in the world is claimed by the Horsfall Destructor Company. This is at Hamburg, and is designed to deal with upwards of 180 tons per day of 24 hours. The Horsfall destructor may be said to be the pioneer of the high temperature type, and



Six-Cell Horsfall Destructor at Accrington.

was in successful operation at Oldham as far back as February, 1891. Additions have since been made, and the steam generated is used in connection with the electricity works, this being the first instance in which a refuse destructor was used for such a purpose. From 1891 to 1896 the cost of repairs averaged only 2½ per cent. upon the capital outlay. The cost per ton for stokers' wages is 9¾d. The saving in coal to the electricity works equals 6·3d. per ton of refuse burned, which, with other economies and the profit on the mortar manufactured, reduces the cost of destroying the refuse to 7·2d. per ton for all charges.

This destructor is of the cellular top feed type, that is, it is divided up into compartments or cells, each having a grate area of about 25 sq. ft. The grate slopes upwards from the clinkering door in front, and terminates in a drying hearth at the back, which curves upwards towards the feeding hole, which is situated at the top and back of the cells.

In some cases the cells are arranged back to back, one feeding hole being common to two cells. This forms a very compact arrangement.

The refuse is tipped from a raised tipping platform into storage bins above the cells, and is raked forward as required and dropped down the holes on to the drying hearths from which it is again raked forward from the doors in front on to the grates. The green gases from the drying refuse pass over the fires to the flues, situate in the front part of the furnace crown.

The air, before entering the furnaces, is heated by passing through air ducts placed between the grates, and the side walls of the cells. Forced draught is, of course, used.

To prevent the escape of dust from the chimney, a centrifugal dust catcher is built at the base. Its construction is such that the gases are caused to circulate rapidly around before passing into a central chamber, from which they pass by a flue to the chimney. The circulatory or swirling action tends to throw the dust against the outer wall of the chamber, and it then gradually settles by gravitation. The contrivance is very successful when used in connection with dusty refuse.

The general arrangement of the Horsfall destructor at the Accrington electricity works is shown in the illustration. The boilers are of the Lancashire type, and the design admits of their being fired by coal if desired in the event of shortage of refuse. The results of this plant were given in Tables IV. and V. (Elec. Rev., August 22nd and 29th, 1902.)

There are several other makes of cellular destructors which, whilst differing in details from the Horsfall, are built upon the same general principles. Descriptions of these may be found in the published works on refuse destruction.

It was shown in the last article that, under suitable conditions, upwards of 40 B.O.T. units of electricity may be generated per ton of unscreened ashpit refuse under normal working conditions, and that the quantity of refuse produced per 1,000 head of population, ranges from about 15 to 22 cwts. per day. Great possibilities are suggested by these facts.

They suggest that besides water power and blast-furnace gas, there may be other sources of power now running to waste, the utilisation of which might not only be commercially profitable, but would be of almost incalculable profit when viewed from the hygienic standpoint.

To place commercial considerations before questions of health, is to put the cart before the horse with a vengeance; but the first question asked in these utilitarian days is usually "Does it, or will it, pay?" *Mens sana in corpore sano* is not yet treated as a marketable commodity, although both directly and indirectly it is a valuable asset in any community. It has already been shown that even in colliery districts it may be cheaper under suitable conditions and in a well-engineered scheme, to burn refuse than coal. Although coal is cheap, the refuse has a high calorific value.

In districts remote from coal fields, while the refuse is sometimes not so good, coal is dearer. Grays is certainly anything but a colliery district, yet a yield of 40 units of electricity per ton of refuse has been obtained there on a test run.

Taking, however, a lower figure, viz., 35 units per ton, and the moderate estimate of 15 cwts. of refuse per day per 1,000 head of population, we find that, if it were possible to burn all the refuse in the United Kingdom (say, 33,000 tons per day) in efficient destructors, we should be able to produce, from this source alone, almost 400,000,000 units of electricity per annum. This amount is sufficient to supply current to over 26,000,000 lamps of 8-c.p., taking the average consumption as 15 units per lamp per annum; and is more than double the output in 1902 of all the electric light undertakings in the kingdom.

Such is the vision that looms in the mind of the imaginative engineer, the engineer who cannot see a hillside stream without forming some mental estimate of the power constantly running to waste, and building water-power houses in the air.

But imagination must not be allowed to run riot; and common sense suggests that it is as commercially impracticable to convey all the refuse distributed over a sparsely-populated district, to one destructor centre, as to centralise the miniature waterfalls which are to be found on every country side. Making, however, ample allowances for such districts, there is still left to us a considerable margin for the profitable utilisation of refuse in towns.

Take a well-peopled town of 20,000 inhabitants. The quantity of refuse for disposal will be upwards of 15 tons a day. At 35 units per ton, this should be sufficient to produce annually about 190,000 units, or sufficient to supply 12,600 lamps of 8 c.p., at the average consumption of 15 units per lamp.

The annual consumption per lamp, however, is a very elastic quantity; and, whilst 15 units per lamp per annum is a very fair average for the whole country, it is not a figure that can be used in considering any particular town. The consumption per lamp depends largely upon local conditions, and varies very considerably with the character of the town; thus at Newmarket, the annual consumption per lamp is 8·2 units, whereas at Islington it is 40. This factor must, therefore, be taken into consideration in endeavouring to arrive at the capacity of any station in terms of lamps.

As has already been pointed out, the economical use of refuse as a fuel for electric lighting stations necessitates accumulators. The lower the rate of combustion in tons per hour, the smaller will be the initial cost of the destructor, and the greater the cost of the accumulator. A compromise must therefore be made, such that the sum of the total costs of destruction, plus total costs of storage, is a minimum. Such costs must, of course, include all standing charges, attendance, battery losses, &c., and the reduced size of generating plant, consequent upon greater storage capacity, must also be taken into consideration.

There is one other point still to consider, and that is, the indestructible residue. After we have done our best, there remains about 30 per cent. of the original mass, in the form of hard, innocuous clinker, and fused dust.

In a town destroying 15 tons of refuse a day, the residue would be about 4 to 4½ tons. What is to be done with it?

Bradford leads the way in this country in the matter of refuse destructors. Six destructors are erected in various parts of the town, capable of dealing with about 300 tons a day.

Up to 1894 it cost the Corporation over £1,000 a year to cart the clinker away to tips.

Since that time many uses have been found for it, such as the making of mortar and concrete, artificial flags, bricks, and road beds.

Now, practically the whole of the clinker is profitably disposed of. In 1900 mortar was turned out at the rate of 12,000 tons a year; 15,000 loads of clinker were sold at 8d. a load; and machinery was put down to produce 200 slabs of artificial stone a day. Bricks made from a 10 per cent. mixture of hydraulic lime and clinker, properly seasoned, are 50 per cent. stronger than the ordinary bricks used in Bradford. Twenty tons of clinker are required for 8,000 bricks, which can be made for 14s. per 1,000. Birmingham, Manchester, Sheffield, Bermondsey and other large towns are also utilising their clinker in this way.

The dust from the flues and the chimney is, in some places, used as a base for the manufacture of disinfecting powder. The cleansing superintendent to St. Luke's Vestry, in a paper read in 1899, says that "the dust is eagerly bought by sanitary powder manufacturers at 2s. a ton, and, after treatment by acid, was sold, in all probability, back to the Vestry at £3 a ton."

By making its own disinfecting powder the Vestry saves about £2 a ton, or £40 a year.

The crude clinker and fused dust form excellent mediums for sewage filtration beds, and are considered to be better than coke for this purpose. Considerable savings, therefore, may be effected by substituting them for coke.

All things considered, there appears to be every likelihood that the commercial possibilities of high-temperature destructors will hasten the general adoption of this, the only sanitary method of dealing with town refuse.

In conclusion, the writer must express his indebtedness and thanks to Messrs. Meldrum Bros., Limited, Messrs. The Horsfall Destructor Co., Limited, Mr. E. J. Long (chief engineer at Grays), Mr. W. Sillery (Wrexham), Mr. D. Schofield (Shipley), and Mr. W. F. Goodrich for data and information freely placed at his disposal.

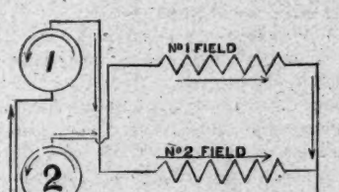
ELECTRIC BRAKES.

By G. H. FAWCUS.

The recent unfortunate tramway accident at Glasgow must have suggested to many tramway engineers the necessity for rendering the possibility of a recurrence of a similar mishap as remote as possible.

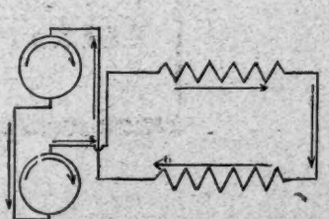
With the little information as yet to hand, it is difficult to understand what happened, and too early to form an opinion as to what was the proper course for the motorman to pursue. But it is apparent that if a car can be prevented from running backwards after it has once stopped, without the use of the mechanical brake, a good deal is accomplished in the direction of security against such accidents, and the writer wishes to show that this can be arranged with simplicity and little or no extra expense.

With the ordinary simple form of electric brake—the motors generating current to be absorbed in a resistance—the motors should be so connected that the armature of each motor excites the field of the other, when running in parallel, thus:—



with the direction of current assumed as shown.

If the direction of rotation be reversed (by the car running backwards, and without the position of the controller handle being altered), the motors will excite and run short-circuited on one another, neglecting the resistance, thus:—



and prevent the car making any appreciable progress.

In explanation, it is assumed that the armature of No. 1 generates sufficient E.M.F., with the residual field, to send a current in the opposite direction through the field of No. 2. This is sufficient to start the armature of No. 2, generating in the same direction as before (both its direction of rotation and field being reversed), and exciting field No. 1, whose polarity remains the same.

With this arrangement it would be advisable for the motorman to always use his electric brake when stopping, and to keep his controller in the "brake" position until restarting the car.

In this we have the novelty of two series machines generating when run in either direction without a change of connections, and that it is quick and reliable in action, the writer has proved by experience.

SINGLE-PHASE PUMPING PLANT AT HAMMERSMITH.

As up to the present single-phase motors have been very little used for pumping purposes in this country, it may be of interest to our readers to describe a plant which has been put down recently by the Hammersmith Vestry, to the design and specification of Messrs. Preece & Cardew, consulting engineers, Westminster.

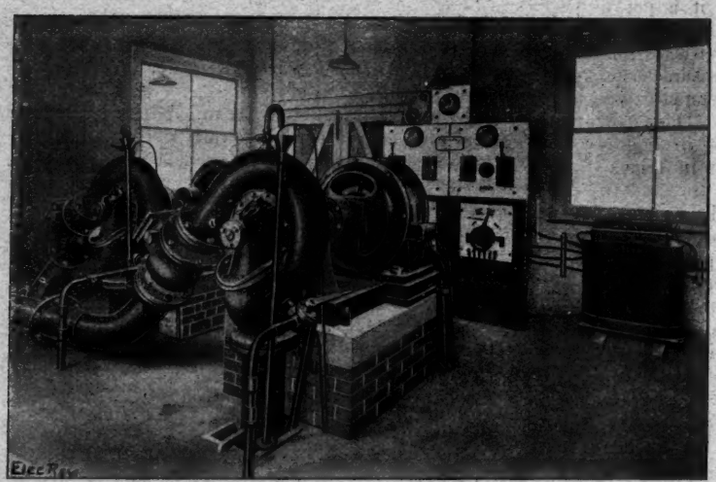


Fig. 1.—Gwynne Centrifugal Pumps driven by Witting Bros.' Single-Phase Motors.

The object of the plant is to pump Thames water for condensing purposes from the Corporation Wharf, Chancellor Road (where the pump house is situated), to an elevated cast-iron tank at the Vestry electricity works, some 700 yards distant. The water flows from this tank with a 12 ft. fall into "Körting" ejector condensers connected with two 1,000 - I.H.P. low - speed "Musgrave" engines direct coupled to 600-KW. fly-wheel alternators, which have recently been installed. A 24-in. cast-iron main, through which the water is forced, connects the pump house to the tank at the power station, and running parallel to this main is a 4 ft. 6 in. brick culvert, through which the water gravitates from the hot well (or condenser discharge) to a suction tank underneath the pump house, or (when the tidal conditions are favourable) directly into the river.

The contract for the whole of the pump house plant was entrusted to Messrs. Witting Bros., Electrical Engineers and Contractors, Limited, Cannon Street, London, who sub-let that for the pumps and pipe work to Messrs. J. and H. Gwynne, of Hammersmith, and that for the high-pressure switchboard to Messrs. Ferranti, Limited.

Mr. G. G. Bell, the engineer and manager to the Vestry's electrical undertaking, superintended the erection of the pump house and plant.

The pumping plant, as at present installed, consists of two single-phase motors of 27 B.H.P. each, mounted on common bedplates with, and direct coupled to, two 8-in. centrifugal pumps, designed to lift 60,000 gallons of water each per hour, against an effective head of 45 ft. when running at 950 r.p.m. Each motor is fed by a separate 30-KW. transformer of Messrs. Witting Bros.' standard design for power work, which transforms the primary current at 2,200 volts and 50 cycles to the pressure of 220 volts, for which the motors are designed.

These transformers are connected by concentric cables to a high-pressure fuseboard of the "Ferranti" standard oil break type, the feeder between this and the power house being a paper-insulated, lead-covered concentric cable, having its outer earthed: this can be plugged on to either transformer, or to both, at the fuseboard.

The low-pressure switchboard, made by Messrs. Witting Bros., consists (as can be seen from the illustrations) of two independent white marble panels, each containing an ammeter, a double-pole switch, and a fuse, a voltmeter being common to both panels; these panels also contain the starting resistances and multiple contact switches for the rotor circuits of the motors.

It will be seen from this description, and from the diagram of connections on p. 534, that the whole of the pump house arrangements are in duplicate, each motor pump, with its transformer and switchgear, being independent and in parallel, so that the risk of a total failure of condensing water is very remote.

The pumps are of Messrs. J. & H. Gwynne's "Invincible" type, having cast-iron bodies, gun-metal discs, manganese bronze shafts, and gun-metal glands. The peripheral speed of the discs is about 4,000 ft. per minute, corresponding to a 45 ft. effective head. Each pump is connected through an 8 in. × 20 ft. suction pipe to a foot valve and wrought-iron grate strainer at the bottom of the suction tank, which has a capacity of about 80,000 gallons. As can be seen from the drawing (fig. 4), this brick-lined tank is connected with the river at high tide by means of a 4 ft. 6 in. inlet sewer with sluice gate. So long as the river level is above the sluice gate, river water can be delivered direct to the condenser tank, the hot water being discharged to the river; but when the tide is lower than the sluice gate, the warm water from the condensers is returned to the suction tank and used over and over again. This circulation, taken in connection with

Fig. 2.—Pump Room and Electric Crane.

the large amount of water stored, is enough to keep the water sufficiently cool to ensure a good vacuum for the engines.

The pumps are primed by means of a 1½-in. pipe connected to a tank which is fed from the town main, and each pump is also fitted with an emptying cock, overflow or air outlet cock, a pressure gauge and vacuum gauge. In addition, each pump is fitted with a non-return flap valve on the discharge side to prevent the pump case from experiencing the

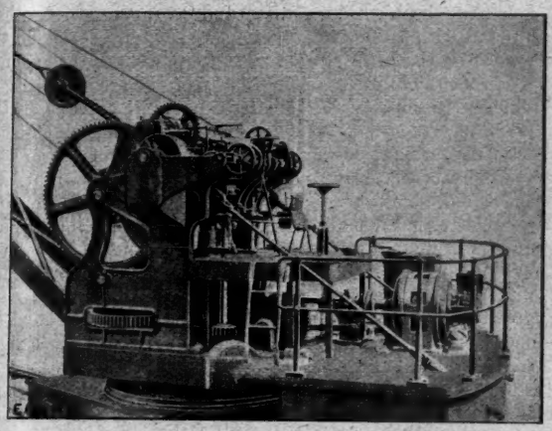


Fig. 3.—Crane Driven by Single-Phase Motor.

return shock due to the momentum of the water in the long length of delivery pipe, as well as to supplement the foot valve and prevent the water from leaking in case the latter becomes blocked by foreign matter from the river.

The motors are of Messrs. Witting Bros.' standard induction type, and are directly coupled to the pumps, no clutches being used.

The special features of these motors are their large starting torques and overload capacities, combined with good efficiency and high power factor. In this connection, it may be mentioned that these particular Hammersmith motors, although designed for 27 B.H.P., have been tested on the brake (at normal supply pressure) at 45 B.H.P. (*i.e.*, 70 per cent. overload), and have been running for almost two hours with 37 B.H.P. (*i.e.*, 40 per cent. overload) without undue heating. Moreover, each motor starts its pump with the pump chamber full of water, with the current gradually increasing from 100 amperes to 135 amperes, which is the full load current.

A non-inductive rotor resistance is used at starting, which is inserted into the (star-connected) rotor windings through the intermediary of slip rings and brushes; the latter are of laminated brass (Boudreaux type), while the slip rings are of steel.

A small auxiliary resistance is used in series with the running phase at starting; this is short-circuited automatically by the auxiliary switch, which cuts out the starting phase when the speed has attained a certain value. As can be seen from the diagram of connections, this auxiliary switch—although electrically insulated from the hand-wheel and the three-way switch which cuts out the rotor resistances—is actuated mechanically by a projection from the hand-wheel, so that the motor is started simply by slowly turning the hand-wheel in one direction.

The stator coils are arranged in a six-pole grouping, which gives a speed of 1,000 r.p.m. at no load. The stator windings are buried in slots insulated with micanite troughs, and as the three-phase rotor is wound in a similar way, the windings being keyed in by means of fibre wedges, these motors are practically indestructible. As they are provided with white metal bearings and efficient ring lubrication, they can be run continuously without any attention whatever. The power factor at full load is 83 per cent. and the efficiency 82½ per cent., so that the motors compare very favourably with direct current machines.

The pump house has ample room to accommodate two further pumping sets similar to those above described, which will be required as soon as the increasing demand for power and light in the district necessitates the laying down of further generating plant.

One of the photographs (fig. 1) gives a good view of the interior of the pump house showing the motor pumps, the low pressure switchboard and transformers, whilst another illustration (fig. 2) gives an exterior view of the pump house and river. This also shows on the right-hand side part of the chains and anchor pillars of the Hammersmith Suspension Bridge on the Surrey side.

This illustration gives a good view of a new electric locomotive jib crane on an elevated gantry, recently installed for the Hammersmith Vestry by Mr. Thomas Smith, of Rodley, near Leeds. The figure shows the crane unloading road metal from a Thames barge.

As this, as far as we know, is the first single-phase travelling crane which has been put to work in this country, and as it derives its power from a transformer in the pump house described above, it may not be out of place to give a short description of it here.

The crane is constructed to lift 5 tons at 16 ft., 2 tons at 35 ft., 30 cwt. at 40 ft., and 1 ton at 42 ft. radius, the lifting speed being 80 ft. per minute for 2 tons and under, whilst the crane travels at 150 ft. per minute on a 7 ft. gauge track elevated to a height of about 7 ft., and makes 1½ r.p.m.

The wrought-steel lattice jib is 48 ft. long, and the crane is balanced to support 2 tons at 45 ft. radius. There are independent motions for hoisting, revolving, jib adjusting and propelling, all driven from the same motor, and so arranged that it is possible to perform all four operations at the same time, although it is not usual or advisable to perform more than two motions at once, on account of the great length of the jib and the rather limited operating space.

The connection between the motor and the first motion shaft of the crane is by means of bevel gearing cut from the solid, and gun-metal worm wheel with steel worm, perfectly enclosed and running in an oil bath.

There is a powerful friction brake operated by foot lever, strong crab and gearing all very compactly arranged, top and bottom swivels, platform and handrail, from which the attendant can readily see and control all movements of the crane, wrought-steel central column, cast-iron frame, steel axles, steel tired travelling wheels, and steel wire rope for hoisting, and the total weight of the crane with a 2-ton load is about 30 tons.

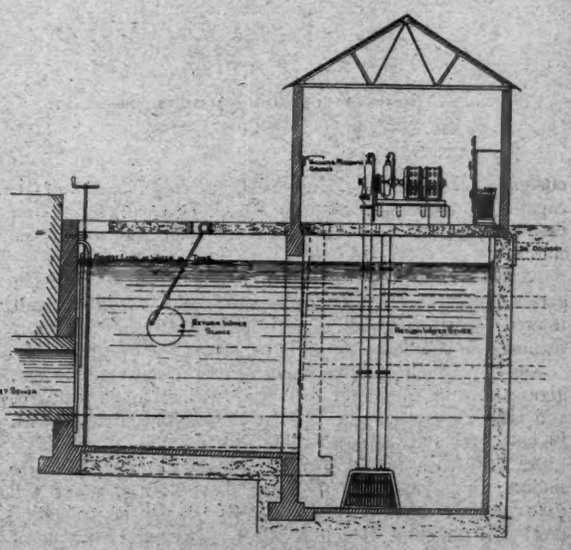


Fig. 4.—Sectional Elevation of Pump House.

The electrical equipment consists of a 20-B.H.P. 50-cycle single-phase motor, of Messrs. Witting Bros.' standard make, similar to those in the pump house, but of the enclosed type, with phosphor bronze rings and duplicate carbon brushes on each ring, and wound for 105 volts at terminals. This low voltage is chosen for extra safety in connection with the insulated third-rail system of supply used with the crane.

This rail is supported on wooden sleepers between the two gantry rails, which act as the return conductors as far as the armoured concentric feeder, connecting the switchboard in the pump house to the three rails. The third rail is insulated with "Verus" insulators, and the current is collected by a special brush which in turn is connected to slip rings at the centre of the crab, from which by means of other brushes connection is made to the motor and controller. This arrangement allows the crane to be revolved indefinitely in either direction.

The motor spindle, which runs at 950 r.p.m., is connected to the worm shaft mentioned above by means of a special friction clutch, but the clutch is not really necessary with this type of motor, as (although designed to start with a

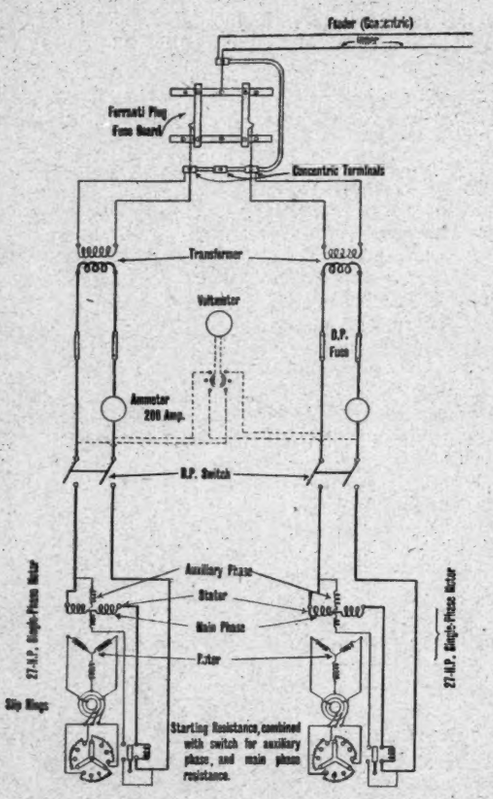


Fig. 5.—Diagram of Connections of Pumping Plant.

current not exceeding full-load current) the motor is capable of starting the worm wheel, bevelled gearing and first-motion shaft in either direction without the use of the clutch.

A suitable controller of the direct-current crane type (in general appearance and design) stands beside the motor, and is used for starting the same in either direction by simply turning one handle to the right or left, as the case may be.

Fig. 3, which shows some of the crane mechanism, gives a view of the motor with the weather shield removed, and slip ring cover open. It also shows the controller with its cover removed, situated behind the motor.

As a further instance of the overload capacity of these motors, we may mention that the above 20-H.P. motor will give at least 30 H.P., and regularly starts the travelling motion of the crane, which requires a momentary output of 28½ B.H.P. whilst accelerating. The actual power required for travelling at uniform speed is, however, only 11½ B.H.P.

It has often been thought that the single-phase motor is not suited for this class of work, but it seems that by employing the arrangement of gearing used on this crane and the motor in question, entirely satisfactory results can be obtained.

The photographs illustrating this article were prepared by Mr. Arthur S. Long, of Fulham Road, S.W.

PROCEDURE ON APPLICATION FOR A TRAMWAY ORDER.

[By a legal contributor.]

Although the progress of electricity has brought about an extraordinary change in the character, and has very materially increased the usefulness of the street tramway, the public statutes which were passed in the days of the horse-car are applicable to its swifter and more modern brother. Content with an Act which was placed upon the book in the year 1870, the Legislature retains the procedure, the groundwork of which was laid in that year, and the details of which were subsequently elaborated in rules published by the Board of Trade. As new tramways are being established every day, which not only provide inhabitants of towns with a swift and inexpensive means of moving from place to place, but actually bid fair to deprive the railways of some considerable proportion of their local traffic, it may interest our readers if we outline the procedure which must be observed by those who promote an electric tramway. After dealing with tramways proper, we hope to draw attention to the provisions of the Light Railways Act, 1896, and to point out the advantages (and disadvantages) of obtaining a light railway instead of a tramway order.

We shall confine our attention to tramways in England and Wales, although the methods to be adopted in Scotland are practically the same.

Who may Apply for a Provisional Order.—It is provided by the Tramways Act, 1870 (Sec. 4), that provisional orders for the construction of a tramway in any district may be obtained by—

1. The local authority of such district, or by
2. Any person, persons, corporation, or company, with the consent of the local authority of such district, or of the road authority of such district, where such district is, or forms part of, a highway district formed under the provisions of "the Highways Acts."

If an application for a provisional order is made by a local authority, it must first be approved by a resolution of the members, passed in the manner prescribed in Part iii. of Schedule A to the Act of 1870. It is there provided that the necessary resolution must be passed at a special meeting; that one month's notice at least must be given of such special meeting; and that, with regard to English tramways, the resolution shall not be passed unless two-thirds of the members constituting such local authority are present, and vote at such special meeting, and that the majority of those present and voting concur in the resolution.

What is Sufficient Evidence of Approval.—Rule 1 of the Board of Trade Rules provides that evidence of approval must be given by (*a*) a certified copy of the resolution approving of the intention to make the application; (*b*) a certified copy of the notice convening the special meeting to consider the application; and (*c*) a certified statement of the number of members constituting the local authority, and of the number present and voting at such special meeting.

Where an application is made by any body or person other than a local authority, evidence of the consent required by Pt. 1, Sec. 4 of the Act (*i.e.*, the consent of the local authority), must be given at the required time by (*a*) a certified copy of the resolution passed at a meeting of the local or road authority; (*b*) a copy of the notice convening the meeting, which notice must contain a statement that the subject of the proposed tramway will be brought before the meeting. Similar evidence of the consent of the local and road authorities must be produced in cases in which the promoters seek to use steam or other mechanical power on any tramway or tramways already authorised. [Note: The substitution of electric or steam traction for horse traction will be dealt with later.]

Power of the Board of Trade to Dispense with the Consent of the Local Authority.—It is provided by Sec. 5 of the Act of 1870, that the Board of Trade may in some cases dispense with the consent of the local or road authority where it is proposed to lay down a continuous tramway in the districts of two or more authorities. If the length of tramway proposed to be laid in a non-assenting district is

less than two-thirds of the entire length, the consent of that body may be dispensed with.

Steps to be taken by the Promoters.—The following notes will give some idea of the dates upon which promoters must take the necessary steps to obtain a provisional order :—

In *October* or *November* next before the application the promoters must publish notice of their intention to make such application. Every advertisement of such application, which is to be published in the manner hereinafter described, must contain the following particulars :—

(*a*) The objects of the intended application ;

(*b*) A general description of the nature of the proposed works, if any ;

(*c*) The names of the town lands, parishes, townships and extra parochial places in which the proposed works, if any, will be made ;

(*d*) The times and places at which the deposit of plans, &c., for public inspection will be made ;

(*e*) An office either in London, or at the place to which the intended application relates, at which printed copies of the draft provisional order when deposited, and of the provisional order when made will be obtainable.

This advertisement is to be inserted :—

(*a*) Once at least in the London or Edinburgh *Gazette*, according as the application is made in England or Scotland ;

(*b*) Once at least in each of two successive weeks in some one and the same newspaper published in the district affected by the proposed undertaking.

The Board of Trade rules provide that an advertisement so published must specify at what point or points, and on which side of the street or road it is proposed to lay such tramway, so that for a distance of 30 ft. or upwards a less space than 9 ft. 6 in., or if it is intended to run thereon carriages or trucks adapted for use upon railways, a less space than 10 ft. 6 in. shall intervene between the outside of the footpath on the side of the street or road and the nearest rail of the tramway. The notice shall also specify the gauge to be adopted, and what power it is intended to employ for moving carriages or trucks upon the tramway.

Street Notices.—It might be thought that the notices above alluded to should be sufficient to draw public attention to a tramway scheme. It is further provided, however, by R. 5 of the Board of Trades rules, that in the months of October and November prior to the application for any provisional order, notice thereof shall be posted for 14 consecutive days in every street or road along which it is proposed to lay the tramway, in such manner as the authority having the control of such street or road shall direct.

On or before November 30th the promoters must deposit certain documents at the office (*a*) of the Clerk of the Peace for every county, riding, or division, and (*b*) of the parish clerk of every parish, and the office of the local authority of every district in or through which any undertaking is proposed to be made, and at the Board of Trade. The documents to be so deposited include—

1. A copy of the advertisement published by them.

2. A proper plan and section of the proposed works, if any, such plan and section to be prepared according to such regulations as may from time to time be made by the Board of Trade in that behalf. It is provided by R. 10 of the B.T. rules that the map is to be on the scale of 6 in. to the mile, and that the plan is to show the exact position of the proposed tramway in relation to the centre of the street or road. Those who are called upon to prepare maps or plans will find minute instructions in the B.T. rules.

Notice to Railway Companies.—In addition to the benefit of the public notices to which we have already referred, railway and canal companies are entitled to special notices. Thus where the works of the promoters cross over any railway or canal, it is provided by R. 6 of the B.T. rules that, on or before the 15th day of December, prior to an application for a provisional order for laying down a tramway crossing, any railway or tramway on the level, or crossing any railway, tramway or canal by means of a bridge, or otherwise affecting or interfering with such railway, tramway or canal, notice in writing of such application shall be served upon the owner or reputed owner, and upon the lessee or reputed lessee of such railway, tramway or canal, and such notice shall state the place or places at which the plans of the tramway to be authorised by such provisional order have been or will be deposited.

Similar notices have to be given to County Councils and proprietors of navigable rivers in respect of their bridges or other works which are proposed to be crossed or otherwise interfered with.

(*To be continued.*)

THE ATOMIC THEORY WITHOUT HYPOTHESIS.

As will be gathered from the title given to it by its author, the Presidential Address delivered to Section B of the British Association at Belfast by Prof. Divers, deals with an exceedingly abstruse and highly polemical branch of chemistry or chemico-physics. Of the ultimate composition of matter—whether many, at any rate, of the substances we are pleased to consider as elements are actually and inherently elemental ; or whether they are all different manifestations of one and the same "Urstoff"—we know nothing ; and opinions are still somewhat divided as to the penultimate composition thereof. The phrases "atomic theory" and "atomic hypothesis" are frequently employed as exact synonyms ; but taking the precise significance assigned to them by Dr. Divers, the atomic hypothesis is the popular form of the idea. According to this, matter is discontinuous or coarse-grained ; a certain substance is made up of an inconceivable number of identical molecules, each of which is, in its turn (usually) composed of two or more atoms. Each atom is so small as to be incapable of further sub-division ; so small that it cannot exist alone ; and each atom, if the substance is an element, in the molecule is identical, whereas different atoms (*i.e.*, atoms of different elements) are present in the molecule of a compound. The hypothesis also assumes that each atom in the molecule is, in comparative language, widely separated from all its neighbours ; so that the molecule, to use the well-known simile, is a microcosmic analogue of a bag of shot. Each atom, moreover, and consequently every molecule, possesses a specific relative weight, so that if the atom of hydrogen is taken as unity for convenience—it having been the lightest body known to chemists—the atom of sodium is 23 times, and that of chlorine 35 times as heavy. In other words, since atoms rarely exist alone, and since there are two atoms in the molecules of each of the substances mentioned, whilst the smallest quantity of hydrogen which can take part in a chemical reaction is two parts by weight, the smallest quantities of sodium and chlorine, similarly active, are 46 and 70 parts by weight respectively. There are difficulties in the way of this conception when carried out logically, and so we come to the atomic theory which, in Dr. Divers's words, is that "the quantities of substances which interact in single chemical changes are equal to one another, as truly equal in one way as equal masses are in another, and therefore that chemical interaction is a measure of quantity of unlike substances, distinct from, and independent of, dynamical or mass measurement." This leads to what is at first sight anomalous, viz., that chemically speaking, sodium chloride should be regarded as a compound of one part of sodium with one of chlorine, whereas physically, or from the mass point of view, it is a compound of 23 parts of sodium and 35 parts of chlorine. We are so accustomed, in scientific inquiry as in daily life, to measure mass by weight, that we are prone sometimes to forget that there are other ways of estimating it, while the learner of physics finds one of his first great difficulties in separating the two ideas. As this is so well-known a trouble to the student, perhaps we may be permitted a coarse illustration. When there is a contested vacancy in Parliament, the returning officer counts the number of people voting for each candidate ; he does not ascertain their collective weights, nor their united heights, nor their brain power ; he determines mass by number of particles, ignoring weight and size altogether. To the election agent one Conservative is exactly equivalent to one Liberal, just as to Dr. Divers one molecule of sodium is equal to one molecule of chlorine ; while one man may be

9 stone and a genius, and the other 18 stone and a fool—totally different in weight and certain properties, as are the two molecules of sodium and chlorine in all respects save combining power.

Dr. Divers proceeds in his address to deal with radicles, which, in opposition to the powers that be, he prefers to spell "radicals," and then he treats of valency, elaborating his argument as clearly, perhaps, as the nature of the subject permits. It seems to follow that our old friend the atom is no longer the property of the chemist. If it is necessary for physical and mathematical reasons for the physicist to think in atoms, and even if, as so many authorities hold, atoms have an objective existence, the raw material of the chemist is the molecule. There is no such thing as chemical addition, only interaction. It is not correct to write the common equation $C + O = CO$; we must write $C_2 + O_2 = 2\,CO$. One atom of carbon does not adhere to one of carbon simply; the two atoms in the carbon molecule, and the two atoms in the oxygen molecule, each separate, and each take new partners, yielding two molecules of carbon monoxide, each of which contains one atom of carbon and one of oxygen. Much of Prof. Divers's address relates to the subtle difference between composition and constitution, which is the basis of organic chemistry. There are hosts of organic bodies—those known as isomers and polymers, &c.—which have an identical composition (*i.e.*, percentage composition), but which differ in physical or chemical properties, or both. These are matters for the chemist mainly to study, and are somewhat beyond our purview; but we may instance the common substance, benzene, whose formula is $C_6\,H_6$, whereas that of acetylene, as different from the former as possible, is $C_2\,H_2$—numerically one and the same thing.

CORRESPONDENCE.

Humming in Pipes.

In a country house, which I recently fitted up with electric light supplied from a steam plant and battery, it was found necessary to run the mains from the engine house to the main distributing board—a distance of about 100 yards and inside a passage. The wires were encased in *two* Simplex steel (ordinary) conduits instead of *one*, in order to keep the work closer to the wall and make it less conspicuous. There are a few turns in the pipes due to arches, and a difference in the level of the ceilings. When the dynamo is running direct on to the house there is a "hum," exactly similar to that made by a small transformer on alternating current; when the house is being lit by the battery the noise ceases. The voltage is 100 (continuous, of course).

Can you give me any explanation as to the cause of the phenomenon and suggest a remedy?

R. C.

Electric Hoists.

"J. G. Y. D. M." might prevent his brake hunting by connecting its winding next to the D.P. switch, in which position the shunt, as well as the armature current, will pass through it. If after trying this the current is too small to lift the brake, he should rewind it.

If this alone does not work well the lift cage might be provided with a false bottom for carrying the page of type. The false bottom would be supported on compression springs, and the stops at top and bottom of the lift well would act on the false bottom and not on the cage itself; the idea being that in this way the necessity for the *cage* to stop *precisely* at certain points would be eliminated. A spring suspension on the cage rope might do instead of the false bottom.

H. W. W. D.

A Question of Trade Etiquette.

We shall be glad if you will give us some information on trade etiquette on the following point:—

Some time ago one of our partners got into conversation with the architect of a hotel which is being put up in the suburbs of this city, and the conversation turned on ventilation. Having friends who make electrically-driven fans for ventilating purposes, we thought we could do them a good turn, and make a little for ourselves at the same time, by introducing the fans to this architect's notice, and found, as we expected, that the subject of ventilation by the method mentioned, had never entered his head.

We met this architect at intervals, and finally, about six months after our initial conversation, and after we had gone to a good deal of trouble with him, he placed the order with us for some electrically-driven fans, and also an electrically-driven pump. At that time we knew the wiring of the building for lighting purposes had not even been tendered for.

Subsequently we received a visit from a gentleman, who informed us that he had received the contract for wiring the building for lighting purposes, and that he also had to run the wiring to our fans, and that the architect had referred him to us for particulars of the connections.

Now comes the part we cannot understand, namely, this wiring contractor coolly demands from us the difference between the price at which we sold these fans to the architect, and that at which we would have sold the fans to him, the wiring contractor.

As we actually created our market, and received our order, long before the wiring contractor appeared on the scene, and as, moreover, this contractor has not even given us an inquiry during the four years we have been in business, we thought this was a bit of cool impertinence, and we should like to know your opinion on the matter, and also that of some of your readers.

Puzzled.

[Personally, we fail to see what the wiring contractor had to do with the transaction between the architect and our correspondents. Apparently he must have mistaken "fans" for "fittings," and on the same principle he might levy toll on every motor, large or small, at present or hereafter to be installed on the premises. However, perhaps the National Electric Contractors' Association can throw some light on the matter.—Eds. Elec. Rev.]

Surface Contact Systems.—We have received a letter signed J. D. F. Andrews, relating to our leader on this subject in our last issue. Mr. Andrews states that he has invented a surface-contact system, and, after the manner of inventors, accuses us of prejudice and lack of knowledge. We have no objection whatever to incurring our correspondent's displeasure, and we are willing to publish his views on the merits of surface-contact systems; but we decline to insert a letter so discourteous as the one before us.—Eds. Elec. Rev.

American Reader.—Probably the following firms would be able to supply you:—A. C. Cossor, 54, Farringdon Road, London, E.C. (mercury pump); Pulsometer Engineering Company, Limited, Nine Elms Iron Works, Reading (mechanical pump).—Eds. Elec. Rev.

ELECTRO-METALLURGICAL PROBLEMS.—I.

By ALEC. A. BEADLE, A.I.E.E., F.C.S.

Copper.

There are 11 important copper bearing minerals, and of these the foremost are the unoxidised ones, viz., copper pyrites and erubesite, double sulphides of copper and iron; copper glance, copper sulphide; tetrahedrite, a double sulphide with antimony; and bournonite, a treble sulphide with lead and antimony. These are usually carried in a matrix of quartz or alkaline earth silicate, and contain, besides sulphur, iron, antimony and lead, varying quantities of arsenic, tin, silver, gold, &c.

Copper exists less abundantly as oxides, blue and green carbonates, silicate and basic chloride; but these present less difficulty in reduction, and are, in fact, welcomed by the smelter to aid in the decomposition of his sulphide ores.

The former unoxidised ores are the most important, and therefore call for the attention of the metallurgist. As is well known, the present mode of reduction is very complicated and expensive, involving as many as seven operations, including electrolytic refining, which, however, can in some instances be reduced to five by treatment of the matte in the Bessemer converter. Thus it would appear that there is here room for a totally different method of reduction, involving fewer operations. The many attempts to solve this problem electro-metallurgically may be said to come under two heads :—(*a*) Obtaining the copper in solution direct from the crushed, raw, or roasted ore, and electrolysis of the solution to reduce from it the metal and to regenerate the electrolyte ; (*b*) imitating the refining of copper, but using, in the place of impure copper anodes, cast blocks of sulphide matte, obtained from the first two operations of ordinary copper smelting.

Among those belonging to the first method may be mentioned that of Body, in which the crushed ore was held in the anode compartment in an electrolyte of ferric salt and sodium chloride, which was caused to flow towards the cathode. At the cathode the copper was deposited, and at the carbon anode the ferrous salt oxidised to a ferric salt, in which the copper and iron sulphides were again soluble, reforming a ferrous salt. This process involved the use of a semi-permeable partition, although the electrolyte was allowed to flow through perforations or over the top, thus avoiding mechanical strain upon it.

The process of Siemens & Halske, following upon this, was on the same principle, but the ore, which was previously partially roasted to convert the copper into cuprous sulphide and oxide and cupric sulphate, and the iron mainly into peroxide, was leached by the ferric sulphate outside the electrolysis vat.

Hoepfner again took advantage of a similar principle, using an electrolyte of cuprous chloride (which deposits its copper at twice the rate of a cupric salt, viz., at 2·36 grammes per ampere-hour) obtained by allowing cupric chloride solution to act upon the copper sulphide ore, which dissolved it, forming cuprous chloride. The solution being oxidised at the anode, after being deprived of some of its copper at the cathode, was again ready to act on the ore. Although these processes have all been given practical trial, they have all failed to fulfil what was at first anticipated, not so much from error in their principle, as through infinite difficulties in their details of working. The regenerated solutions soon became charged with impurities, and, moreover, even when the ore was pulverised to a great state of fineness, it was found difficult or impossible to dissolve out the complete copper contents. There is also great difficulty in finding an anode, carbon and lead both being attacked in the chloride. The high voltage and low current efficiency caused in exhausting such solutions of their copper cause the consumption of energy to be prohibitive.

The Marchese process is an instance of the second method, in which copper matte (which like the natural sulphides of copper and iron, is a fair conductor), containing about 15 per cent. copper, 40 per cent. iron, 14 per cent. lead, and 25 per cent. sulphur, was cast into plates containing copper rods or net which formed the connection and reduced the apparent resistance of the matte. These plates were made the anodes in an electrolyte of copper sulphate, and treated as if ordinary impure anodes in copper refining. Many difficulties, however, arose in this process, the anodes, which were themselves very brittle and weak, became covered with sulphur, disintegrated copper, and iron sulphides and lead peroxide, causing a very high P.D. across the bath. There was, however, another difficulty, the cyclical oxidation and reduction of the iron salts at the anode and cathode respectively, causing a great reduction in current efficiency. Although the separation of copper from mattes still leaves two preliminary operations to be performed, it is evident that, could it be done economically, a great step would have been made, for the copper contents of a matte being much higher than that of the original ore, it can, in this form, be carried more cheaply to the refinery.

Nevertheless, there is more of a future for a process which will dispense with the concentration of the matte.

In dealing with this subject the constitution of an ore is too often overlooked. It should be noted that an ordinary ore consists of two distinct parts :—(1) The mineral which it is required to decompose and reduce; and (2) the gangue and undesirable minerals which it is our object to get rid of. In endeavouring to find a solvent or other means of decomposition, therefore, although we want, if possible, to leave the second part unaltered, we must decompose, or at least completely chemically disintegrate the metal-bearing mineral. For this reason, before attempting to deal with any particular ore, it is necessary to determine, by careful examination, not only its percentage composition, but also in what form each of its constituents is present.

Having, however, obtained our copper in solution by some means, it is then necessary to deposit it as rapidly, and in as pure a condition as possible. In this latter connection the sulphate is eminently satisfactory, owing to the deleterious metals, tin, bismuth, antimony, lead, arsenic and iron, along with the noble metals, being either precipitated with the slime as hydrated oxides or basic sulphates, or remaining as an electro-negative coating on the anode. But the safe rate of deposit is slow, not exceeding 15 to 20 amperes per square foot.

The author has shown (the *Electro-Chemist and Metallurgist*, July, 1901) that the safe rate of deposit is roughly proportional to the amount of copper in solution, and therefore is dependent upon the solubility of the salt. The nitrate being by far the most soluble salt has, then, the highest safe rate. It is soluble in its own weight of water, but a solution containing only 360 grammes of copper per litre can be made having exactly the same specific resistance as the acid solutions of the sulphate ordinarily used in refining, which contain about 200 grammes of copper per litre. From this solution the metal can be deposited in a smooth, tough form, at a current density of 40 amperes per square foot with high current efficiency. Nitrate of copper is more expensive than the sulphate; slightly more E.M.F., too, is required to maintain the increased current density, and more is locked up in a given quantity of solution; but it must be remembered that against this the anodes and cathodes are less than one-half of the time in the electrolyte, and therefore the capital has a quicker turnover, and, in addition to this, the output for given floor space and vats is higher.

With regard to the purity of the metal deposited, not much seems to be known, but undoubtedly the gold is not dissolved at the anode, although at high anode current densities the silver passes into solution. It is possible, however, that some of these difficulties may be overcome by the addition of a small quantity of chloride, or even sulphate, to the electrolyte, and this may also aid in the precipitation of the other metals which are undesirable in the copper. As is the case with the sulphate, a very rapid circulation of the electrolyte enables a greatly increased current density to be used.

The refining of copper mattes in nitrate solution, too, deserves attention, as it presents several features worthy of note. The anode is attacked and disintegrated in proportion to its copper contents, the sulphur, together with iron sulphide and oxide, being left as a non-coherent crust. Some of the iron being dissolved, however, is thrown down as hydrated peroxide at a slightly elevated temperature, and does not interfere with the current efficiency of the deposit. The nitrate solution does not creep like the sulphate. The author has found that from a copper matte (containing about 30 per cent. of copper) treated in this way, very tough and pure copper can be deposited with a current efficiency of 89 per cent., and the iron which may get into solution is precipitated as ferric hydrate.

The voltage necessary on account of the high resistance of the matte anode was 3—4 volts, which means, at ¼d. per unit, over ½d. per pound of copper produced. Being due to the high resistance of the matte anodes, it could probably be largely obviated by suitable connections and by keeping the anode free from non-conducting crust.

A process has been worked for some years in Pforzheim (Germany) for the refining of an alloy containing 40—60 per cent. copper, and a large proportion of gold and silver, using a slightly acid solution of nitrate. In this it is said that the current density is 150 amperes per square metre at a voltage of from 2·5 to 3.

The reduction of copper from fused salts does not promise to be of value on account of the high melting point of

the metal. Hydrous chlorination at the ordinary temperature, anhydrous chlorination at an elevated temperature, chloridising roasting, roasting to oxydise sulphides to sulphates and acid treatment, are among the many ways suggested and tried for obtaining the copper in solution. It has been suggested to electrolyse the fused sulphide, but the peculiar power possessed by copper and iron sulphides, and shared by many others, of conducting almost as a metal instead of an electrolyte, and of dissolving both the metal and sulphur in any proportion, seems to bar the way in this direction. It is, however, possible to reduce the sulphide electrolytically in presence of some fused fluxes.

REVIEWS.

Motors and Motor-Driving. By A. Harmsworth and others. London: Longmans, Green & Co. 1902. Price 6s. net.

This is a volume in the well-known "Badminton Library" series, which was supposed to come to an end with "The Poetry of Sport"; but "motoring" is claimed as a new sport, and therefore no excuse is offered for its inclusion. The book is compiled of chapters written by most of the leading motor "sportsmen," only one chapter being contributed by the nominal author, on "The Choice of a Motor." Naturally, the bulk of the work is devoted to petrol cars, with a chapter each on steam and electric cars, but many of the sections are largely applicable to automobiles of all kinds, such as the chapters on "Dress," "Motor Cars and Health," "Tyres" "Roads," "Points of Law," &c.

The book is full of interest to the general reader, though the engineer will gain but little from its perusal. Such samples of mechanical drawing, for instance, as that on p. 105, where the cylinder of a petrol engine is shown in section, with the fly-wheel in perspective, the crank at its extreme outward position, and the piston at its extreme inward position, will only provoke his laughter. The chapter on "Ignition in Petrol Engines" was written by Mr. J. E. Hutton, A.I.E.E., and is chiefly devoted to electrical ignition; the subject is dealt with in an elementary, but accurate, manner, all the best-known systems are fully described. A figure seems to have been omitted on p. 158. The Hon. C. S. Rolls contributes a chapter on "The Caprices of the Petrol Motor," of which Part I. is appropriately headed, "The Motor will not Start;" in Part II. on "Road Troubles," the first section is headed, "Motor Stops Completely." Other sub-heads are equally amusing and significant, such as "Fits and Starts," "Unusual Noises," "Bursting Noises (irregular) coming from the Engine," "Loud Report in Exhaust." We hasten to add that this chapter is extremely practical and instructive, and ought to be one of the most useful in the book. It concludes with sage advice in brief, from which we cannot resist one more quotation, "If you have a flare-up . . . . take off bonnet to save the paint."

The chapter on "tyres," by which is meant "tires," is written by Mr. C. L. Freeston, and is of interest to electromobilists. Full instructions are given for the handling and repair of the Michelin and other tires. The subject of steam cars is well handled by Mr. H. W. Staner, editor of the *Autocar*, while the editor of the *Automotor* treats of electric cars, and the editor of the *Motor Car Journal* deals with motor cycles.

The chapter on electric cars is very simply and intelligibly written, evidently with a view to the edification of the novice. It is not quite free from errors or inaccurate statements; for instance, describing a solenoidal current, the author says, "it will have one pole near where the current comes in and another pole where the current goes out." But suppose there are two layers; what then? Also, we learn that a steel core differs from iron in that "it will take some time to become magnetised." On p. 284 the drawing of a "shunt-wound motor," fig. 5, is shown with the currents flowing in such directions that it can apply only to a generator, not a motor. The author's views on motors are peculiar, and we doubt whether such passages as the following will be of much assistance to his pupils:—"An electric motor is a machine which produces rotary movement owing to the magnetic action caused by an electric current." A soft iron ring with a wire continuously wound round it, with brushes, through which an electric current is passed, becomes magnetic, like two half-ring magnets put together, and when mounted between the poles of an electro-magnet "there will be a permanent pull on one of its pairs of poles in one direction and a permanent pull on the other pair of poles in the opposite direction. Now the position of these poles in space is permanent, and depends upon the position, as already explained, of the brushes B and B^1. The result is that perpetual rotary pull or *torque* is produced in the ring and it turns round." It is difficult to see how the permanency of the position of its poles in space produces perpetual rotary pull in the ring! Without going too much into detail, however, the author succeeds in presenting a very fair account of the properties and peculiarities of electric motors, batteries, and cars to his readers. He is not without humour—witness his recommendation with regard to a motor armature which is afflicted with a partial short-circuit in its windings: "It is better to rewind or get rid of a motor in this condition." Apparently the ways of the wily horse dealer—amateur or professional—are looked upon as legitimate in motoring.

The instructions for testing the continuity of the winding are slightly incomplete—the author appears to forget that there are two paths round the armature; and his advice on testing controllers, p. 306, if followed when the battery is on, is likely to lead to serious happenings in the galvanometer.

The rest of the book contains valuable advice about driving, a eulogy of motor-driving, essays on roads, and on the relations between motor cars and horses, reminiscences, &c., &c. Not the least useful section is one giving the motor laws as they exist, *verbatim*.

Electrical Catechism. Compiled from *Power*. New York: Hill Publishing Company. 1902. Price $2.

The volume before us is mainly a reprint of 533 questions and answers which appeared in serial form in the pages of *Power*. The catechetical method of imparting information does not appeal to ourselves, but we presume that it must be fairly popular over the water, as many American writers have adopted this plan—and the American does not usually waste his efforts if he knows it.

We could forgive the style, however, were the matter accurate; unfortunately, errors are by no means infrequent. We do not propose to tabulate more than a few of those that we have noticed in a cursory examination of the book—we emphatically decline to read it through—but the following are fair samples:—

Page 30: "The heat units developed per second are proportional to the watts passed through the wire. The rise in temperature is proportional to the watts divided by the affective (*sic*) radiating surface."

This is sufficiently misleading, but what are we to think of the following astounding statement?—"As 778 heat units equal 1 foot-pound, and 1·35625 foot-pounds per second equal 1 watt, 1,055·1625 heat units per second will be developed when 1 watt is applied to a circuit" (p. 31). The author multiplies where he should divide, and calculates the result to *eight significant figures!* This is a prodigy of painstaking carelessness.

Again, p. 33, explaining the construction of a four-pole dynamo, the author says of the armature, "a drum winding may be arranged exactly as it is for a bi-polar field, and the two additional brushes used." This is nonsense; such an armature would generate no terminal P.D. at all in such a field.

On p. 51 we are told that the speed of a motor is usually regulated "by means of a rheostat in series with the armature; field regulation is employed in some special cases, but the other is the common method." This relates to a

shunt motor, according to the context; we trust that it is not true, even in America—it is certainly not so here.

After dealing with elementary ideas and principles, the author passes on to systems of wiring, measuring instruments, single and polyphase currents, transformers, rotary converters, electric lighting, &c., the scope of the book being therefore very extensive. The advanced portions of the work are treated with more confidence and familiarity than the practical and elementary sections, by which we are led to suspect that the catechism was compiled by a writer better versed in theory—especially mathematical theory—than practice. A formula of this kind, for instance, certainly does not convey the impression of habitual use:—

$$E_1 = \frac{\phi \times N \times f}{22{,}522{,}522{\cdot}5225}$$

We wonder why the author stopped at 12 significant figures, when the recurring decimals afforded him such a good opportunity to go on *ad infinitum*.

We are pleased to note that the error which we pointed out some time ago, when the serial was in progress, viz., the statement that the resistance of a 16-c.p. 112-volt lamp is ½ ohm when hot, although it still stands in the text, has been corrected in the *errata*.

Summing up, we consider that, in spite of some serious blemishes, the work contains a remarkable amount of information, and should be very useful to those who like their science in homœpathic doses.

ENGINE REQUIREMENTS FOR THE PARALLEL OPERATION OF ALTERNATORS.*

By E. M. TINGLEY.

In connection with its extensive work in electrical engineering the Westinghouse Electric and Manufacturing Company has been called upon from time to time to give information and suggestions regarding engine requirements for the parallel operation of direct-connected alternators. In response to these requests the desired information has been crystallised into the form of a specification, which is often embodied in the contract for generators or sent to engine builders for their information. The specification is as follows:—

A. The engine governors should be so constructed that there is no tendency to cause a periodic transfer or surging of the load between one engine and another. This tendency may originate in the angular variation of velocity in different parts of the revolution which is common to all reciprocating engines, or in a sudden variation of load which will affect each governor in a slightly different manner, or in other causes that lead to a non-uniform speed. The engine governors should not be sensitive to such disturbances nor maintain or increase them. The effect on the engines of a periodic transfer of load occasioned by hunting between two engines running in parallel, is somewhat similar in effect to throwing the load on and off a single engine at short equal intervals which may be measured by one or several pulsations in the combined turning efforts applied to the engine shaft. In some extreme conditions the pulsations of load may amount to more than the normal capacity of either engine. With no external load one engine may then alternately drive the other, which will evidently be a more severe condition than if the load were only applied to and removed from a single engine. If under any case of pulsating load the engines do not tend to accentuate the pulsations in turning effort and speed, then a condition favourable to parallel running is attained.

B. Variation of the rotating part of the generator through one revolution at any constant load not exceeding 25 per cent. overload should not exceed one-sixteenth of the pitch angle between two consecutive poles from the position it would have if the motion were absolutely uniform at the same mean velocity. The maximum allowable variation, which is the amount the rotating part forges ahead plus the amount which it lags behind the position of uniform rotation, is, therefore, $\frac{1}{32}$th of the pitch angle between two poles. Generally this is obtained by the use of a heavy fly-wheel. In a two-pole machine this variation is equivalent to 5° as measured on the circumference of the rotating part; in a four-pole machine it is 1¼°, and in a six-pole machine 1°, or as the number of poles increases the permissible angular variation decreases.

C. The engines should have practically the same characteristics of speed regulation in order that the power delivered to their respective generators may be proportional to the load; that is, the same load on any engine should produce the same percentage drop in its speed. This is most readily obtained in engines in which at full load the speed drops from 3 to 5 per cent. below the no-load speed, as a slight change in adjustment of the governors will have less relative effect than in engines in which the speed drops only 1 per cent. under the same variation of load.

D. The use of governors which are adjustable while the engine is running is recommended. Slight adjustments of speed may then be made which will facilitate synchronising the alternators or changing the load carried by the engines.

Maximum Permissible Variation on Either Side of Uniform Rotation.

Poles.	Angular degrees.	Per cent. of circumference.
4	1·500	0·41666
6	1·000	0·27777
8	0·750	0·20833
12	0·500	0·13888
16	0·375	0·1041
20	0·300	0·0833
24	0·250	0·0693
28	0·214	0·0594
32	0·187	0·0520
36	0·167	0·0462
40	0·150	0·0416
44	0·136	0·0378
48	0·125	0·0347
52	0·115	0·0320
56	0·107	0·0297
60	0·100	0·0278
64	0·094	0·0260
68	0·088	0·0245
72	0·083	0·0231
76	0·079	0·0219
80	0·075	0·0208

It may be noted that there is no attempt to tell how these results are to be obtained; this is a problem for the engine builder.

Some of the effects of pumping may be reviewed by considering the simplest case in which pumping occurs, namely, when two alternators are in parallel with no external load. If the alternators will work in parallel under this condition they will usually work together under load or with one or more additional units. When the two machines are connected together after being properly synchronised, nothing unusual will happen for a few seconds, but soon the ammeters will show cross-currents between the alternators as pumping commences, indicating differences of phase. The voltage of the two machines is lowered by these cross-currents and is pulsating, and, therefore, unsuitable for lighting service. The generators may also grow warm on account of the cross-currents or give out sounds indicating unusual internal mechanical forces. If the pumping increases in severity, fuses may blow, circuit breakers open, or the generators may finally go entirely out of step.

The engines meanwhile may not show that anything unusual is happening, leading some to assume that the trouble is all in the generators. If, however, as in some cases, it is possible by looking through the arms of the fly-wheels to see the change in the relative angular positions of the wheels of the two engines, it will be evident that there is an actual oscillation between the two machines such as might be expected to occur if they were coupled with an elastic coupling. These disturbances are usually traceable to the engine governor, since if they were not maintained by some regularly-recurring change in steam distribution they would soon die out on account of the frictional resistance to such oscillations.

Consider, for example, a case where a load is thrown on and off a single engine and generator by a suitable switch at regular intervals. The governor may lag in its correcting effect and then overshoot the mark in maintaining an average speed. If the load is applied or removed at the instant when the governor and engine begin to recover from one of these excessive speed corrections, the effect is maintained or is made cumulative, and the engine varies periodically in speed. Now, if this intermittent load is replaced by another engine and generator there may be a resonant action between the governors on the one hand and the synchronising force between the generators and inertia of the rotating parts on the other, which will produce the same action on the governors as did the intermittent load. The oscillations may be started either by the angular variation in speed which occurs in all reciprocating engines, or by changes of load.

In order to assist engines in parallel running, it is now usual to apply dampers to the poles of the generators and synchronous machines in circuit with them, but dampers do not ensure parallel operation nor are they always necessary. When the best form of damper is ineffective in reducing pumping to an allowable amount, it means that the impulses from the engines are greater than can be corrected for in the generators.

Paragraph B of the foregoing specifications limits the angular variation from uniform velocity solely in order to limit the value of the cross-currents between generators to what is considered a reasonable amount. The angular variation is usually calculated from the variations in crank effort and the fly-wheel capacities of rotating parts, since its correct measurement is exceedingly difficult.

Engines running with cranks in step will give better performance as regards themselves than with the cranks out of step, especially if the angular variation is large, since the angular difference between the two generators may be at all times smaller than the divergence from absolutely uniform rotation. With the engine cranks out of step there may be larger cross-currents between the generators, but the fluctuation in the outside circuit will frequently be smaller than with the cranks in step, since it will be due to the resultant action of two or more engines.

The stipulations of paragraph C in the specifications are intended

* Abstract of a paper read before the Engine Builders' Association, Pittsburg.

simply to ensure a proper division of load between two or more engines. Adjustable governors are recommended in paragraph D for the purpose of transferring the load from one generator to another in order to facilitate switchboard operation. Moreover, the engine governors will sometimes vary in their own adjustment, making it necessary to make corrections from time to time in order to obtain a proper division of the load. Adjustable governors also enable an unloaded engine to be synchronised with one running loaded.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Sept. 24th, 1901.		Week ending Sept. 23rd, 1902.	
Adelaide	Value £76	Alexandria	Value £248
„ Teleg. cable	2,400	Amsterdam	110
„ Teleg. mat.	139	Antwerp	88
Alexandria. Teleg. mat.	1,007	Auckland	150
Amsterdam	57	Bangkok	29
Bangkok	36	Bombay	214
Beira. Teleg. mat.	85	Buenos Ayres. Teleg. mat.	84
„ Teleph. mat.	108	„ Teleph. cable	550
Bombay. Teleg. mat.	49	Calcutta	376
Brisbane	115	Cape Town	264
Buenos Ayres. Teleg. mat.	150	Channel Islands	20
Calcutta	906	Christiania. Teleg. wire	23
Canaries. Teleg. cable.	10,140	Colombo	145
Cape Town	616	Copenhagen	75
„ Teleg. mat.	489	„ Teleg. wire	113
„ Telephones.	122	Delagoa Bay	40
Chinde	22	„ Teleg. mat.	841
Copenhagen. Teleg. wire	89	Durban	792
Durban	22	Ghent	10
East London	94	Lisbon	55
„ Teleg. mat.	219	Madras	352
Fremantle	60	Malta	16
Hobart	59	Nagasaki	21
Hong Kong	27	North Atlantic. Teleg. cable	2,180
Madras. Tramway cable	759	Ostend	40
Melbourne	50	Perth	298
Otago	1,925	Port Elizabeth	210
Perth	457	Stockholm. Teleg. wire	94
Port Elizabeth	370	Wellington	198
St. Michael's. Teleg. mat.	24		
St. Petersburg	81		
Shanghai. Teleg. wire	29		
Singapore	110		
„ Teleg. wire	12		
Stockholm	460		
„ Teleg. wire	110		
Sydney	498		
„ Teleg. mat.	107		
Tokio	243		
Valparaiso	60		
Yokohama	321		
Total	£21,824	Total	£7,581

Foreign Goods Transhipped.

Gothenburg. Elec. appa.	Value £108	Auckland. Elec. goods	Value £200
Sydney. Elec. mat.	253	Sydney. Elec. lamps	100
Total	£361	Total	£300

Books Received.—"Report of the Proceedings of the International Engineering Congress (Glasgow), 1901, and Abstracts of the Papers Read." Glasgow: Wm. Asher; and University College, London. 1902.

"Year Book of the Michigan College of Mines, 1901—1902.' Houghton, Michigan: By the College. 1902.

"Proceedings of the Incorporated Municipal Electrical Association, 1902." Published by the Editing Committee of the M.E.A. 1902. 3s. 6d.

"Fire Tests with Roofs." No. 72. London: The British Fire Prevention Committee. 1902. 2s. 6d. net.

"Subject List of Works on the Textile Industries and Wearing Apparel in the Patent Office Library." London: The Patent Office. 1902. 6d.

"The Automobile: its Construction and Management." By Gérard Lavergne, Revised and Edited by P. N. Hasluck. London: Cassell & Co., Ltd. 1902. 10s. 6d. net.

"The Elements of Electrical Engineering." By Tyson Sewell. London: Crosby Lockwood & Son. 1902. 7s. 6d. net.

Belliss Engine Contracts.—The tenders of Messrs. Belliss & Morcom, Limited, have recently been accepted in the following instances:—For the Langho Inebriates Home, two 40-H.P. engines for coupling to Laurence-Scott dynamos; for Pemberton, two 540-H.P. engines for coupling to Dick-Kerr dynamos; for the Wolverhampton Workhouse, two 88-H.P. engines for coupling to Electric Construction Co.'s dynamos; and for Gateshead, one 730-H.P. engine for coupling to Siemens & Halske dynamo.

Strike Ended.—A strike of car builders at the Castle Car Works, Hadley, which affected nearly 300 men, came to an end on Saturday last. Work was resumed on Monday morning. Most of the men who were on strike were engaged in building the new electric cars for the Mersey Railway Company.

Portable Heater.—The Wells heater is being supplied to a number of electrical firms by Messrs. A. C. Wells & Co., of St. Pancras. It is a very handy contrivance in engineering and repair operations, where portable heat from oil may be applied instantly to all classes of work for bending, straightening, expanding, &c. It is claimed to give a hot powerful flame, which deposits no soot, by the vaporisation and combustion of ordinary paraffin oil in a specially-constructed burner. This burner is connected to a portable oil tank by means of flexible tubing, and is so arranged that it can be slung or fixed in any position and turned in any direction to suit the work. Lists giving prices of the different sizes can be obtained on application to the above firm. It may be mentioned that Messrs. Witting Bros. recently made use of four of these heaters when placing in position two shrinking rings of 56 in. external diameter, and with a cross-section of 6 in. × 6 in. Two of these rings were successfully heated and placed in position in five hours, which is considered a good performance in view of the fact that the space was restricted for working in, and that they had to be placed in a very awkward position.

The Electric Lamp Regenerating Co., Ltd.—A winding-up order having been made against this company, the statutory meetings of the creditors and shareholders were held on Friday 19th inst. at the London Bankruptcy Court, before Mr. H. Brougham, Official Receiver. The accounts filed by the liquidator show liabilities £2,386 expected to rank, against assets estimated to produce £4,740, after payment of £14 to the preferential creditors. The assets consist of cash, £42; stock-in-trade, £70 (estimated cost £124); machinery, £600; fixtures, fittings, &c., £200; English factory and patent, and foreign patents, £1,000; French and Spanish factories and patents, £2,811; good book debts, £27; and bad and doubtful debts valued at £3 18s. The account with the contributories discloses a total deficiency of £77,645, which is explained as follows:—

Expenses of carrying on business in London from date of formation of company to date of winding-up order, viz.:—			
Salaries and wages (including managing director)	£2,207 18 6		
Rent, rates and taxes	448 19 4		
Miscellaneous trade expenses	276 6 4		
		2,933 4 2	
Bad debts		6 4 10	
Directors' fees from date of formation of company to date of winding-up order		484 4 6	
Depreciation on property not written off in company's books, viz.:—			
Stock-in-trade at Fulwood's Rents	54 4 6		
Machinery at Do.	629 5 4		
Trade fixtures, fittings, office furniture, &c., at Fulwood's Rents	318 17 6		
English factory and patent and foreign patents	66,862 9 6		
French and Spanish factories and patents	5,173 7 2		
		73,088 4 0	
Other losses and expenses from date of formation of company to date of winding-up order, viz.:—			
Preliminary and organisation expenses	947 14 8		
Law costs	186 7 5		
Alterations to premises at Fullwood's Rents	60 5 10		
Experimental work	8 13 2		
		1,203 1 1	
		£77,664 18 7	
Less:— Gross profit arising from carrying on business in London from date of formation of company to date of winding-up order		19 6 6	
Deficiency as per statement of affairs		£77,645 13 1	

Note.—The loss on the French and Spanish factories, £5,173, shown in the above account, is arrived at by deducting from the total amounts expended in acquiring and carrying on these factories the amount for which they have been sold.

The following are the observations of the Official Receiver upon the company's formation and transactions:—

The winding-up order was made on August 5th, upon a creditor's petition, presented to the Court on July 12th last. The Official Receiver was appointed provisional liquidator on July 16th, pending the hearing of the petition. The company was incorporated on March 7th, 1901, with a nominal capital of £80,000, in shares of £1 each, and was formed to carry on the business of lamp manufacturers and electrical and mechanical engineers. The promoter and vendor was Mr. C. Williamson Milne, and the company was formed to acquire from him certain British and Foreign patents for improvements relating to the manufacture and repair of incandescent electric lamps, and the business and assets of a syndicate working the patent in England, whose interests he had acquired. The directors appointed under the articles of association were Messrs. C. Williamson Milne, W. J. Davy, F. Fanta and Captain E. I. Rex. No other directors have been appointed. Mr. Fanta vacated his seat on May 6th, 1902, and the remaining directors were in office at the date of the winding-up order. Mr. Fanta was appointed managing director, at a salary of £600 per annum. The qualification of a director was the holding of 500 shares in the company, and the whole of the directors were duly qualified. Their remuneration was fixed at £150 per annum to the chairman, and £100 per annum to each director, with 10 per cent. on net profits, after payment of a dividend of 10 per cent. No remuneration has been paid to the directors.

No prospectus has been issued, the company being registered with a declaration that there was no intention to issue any invitation to the public to subscribe for shares. The whole of the capital has been issued, £20,000 against cash subscriptions, and £60,000 credited as fully paid in part payment of the purchase consideration. Of the subscribed capital £17,000 was provided by Mr. Milne and his friends. The property, patents, &c., purchased by the company were acquired by Mr. Milne in terms of an agreement dated January 30th, 1901, and made between the Electric Incandescent Lamp Regenerating Syndicate, Limited, Mr. F. Fanta, and Mr. Milne. Under this agreement the syndicate sold to Mr. Milne the British and foreign patents and applications for patents, and the exclusive right to apply for and obtain in all countries letters patent in respect of improvements in and relating to the manufacture and repair of incandescent electric lamps, also the assets, property, and undertaking of the syndicate in London, with the benefit of and the obligations (not exceeding £7,000) of a certain contract for the purchase of two factories in France and Spain, at Paris and Barcelona respectively. The consideration of the said sale was the sum of £44,750, payable as to £8,750 in cash, and as to £36,000 in fully paid up shares of a company to be formed with a capital of £80,000. The capital of the syndicate (formed in August, 1900, to work the English patents) was £7,500. The syndicate had a factory at Fulwood's Rents, Holborn, W.C., but only experimental work had been carried on.

Under an agreement dated March 18th, 1901, between Mr. Milne and the Company, the latter acquired the whole of the property purchased by Mr. Milne under the agreement of January 30th, 1901. The consideration therefore was £68,750, payable as to £8,750 in cash, and as to £60,000 in fully paid up shares, the company undertaking to discharge the obligations (not exceeding £5,000) of the syndicate to pay for the factories in France and Spain. The property was duly assigned to the company, and the £8,750 paid by two equal instalments on March 20th and April 4th, 1901. The 60,000 fully paid shares have been allotted to Mr. Milne and his nominees. The £8,750 in cash was paid direct to the syndicate, and 36,000 of the 60,000 fully paid shares were allotted to the syndicate, Mr. Fanta and their nominees. Of the remaining 24,000 fully paid shares 9,000 were allotted in terms of the purchase agreement of March 18th, 1901, to Messrs. M. D. Rucker (3,750), C. Lumb (3,750), J. H. Lumb (1,000), and W. J. Davy (500), for introducing the property to Mr. Milne, and for services rendered. It therefore appears that the profit made by Mr. Milne on the re-sale of the property to the company amounted to £15,000 in fully paid shares. As regards the French and Spanish factories, after negotiations with the owners, the

purchase price for the factories was ultimately agreed at £4,000, which was paid in cash, with £257 legal charges. The company has expended £2,456 on the French and Spanish factories in respect of additional equipment, improvements, &c. The trading at both factories has resulted in a loss, that at the French factory amounting to about £600 to the end of March last, while the accounts of the Spanish factory disclosed a loss of £612 at the date of the winding-up order.

The result of the trading at the London factory to June 30th last was a loss of £3,229. No accounts were submitted to the shareholders, but a statement showing how the capital of the company had been expended was set out in a circular issued to the members on May 17th last. The working capital having become exhausted, the shareholders were invited in May last to subscribe to a loan to the company, but in consequence of the subscriptions falling short of the minimum amount (£4,000) to be subscribed, it was decided to endeavour to reconstruct the company upon the basis of an issue of new shares, with a liability of 3s. 4d. per share, but before this could be given effect to the winding-up order was made. The failure and insolvency of the company is attributed by its officials to insufficiency of working capital, bad management, and to the difficulty of working the two Continental factories from London. The Official Receiver was advised that it was open to creditors in both France and Spain to at once take steps to realise the property there for their own benefit without regard to the claims of the British creditors, and negotiations were entered into with the view of at once disposing of these assets. As the result an offer of £2,000 in cash for the whole of the company's assets in France and Spain, the purchaser undertaking to discharge all the liabilities of the company in those two countries, amounting to about £800, was accepted, with the approval of the principal creditors and the sanction of the Court.

The Chairman reported to the creditors that he had in hand sufficient funds from the sale of the French and Spanish assets to pay all the liabilities in full. Under those circumstances the liquidation more closely affected the shareholders than the creditors, and he would suggest that the committee of inspection should be selected from the more interested body. A resolution was unanimously agreed to by the creditors for the Official Receiver to act as liquidator and be assisted by a committee of inspection to be named by the shareholders. The meeting of the shareholders was next held, and a resolution confirming the selection of the Official Receiver as liquidator was passed. The following gentlemen were selected to form a committee of inspection, viz., Mr. Walter Thomson, Mr. John J. Reed, and Mr. Lindsay, K.C., Mr. Satchell and Mr. Milne.

Appended is a list of the principal creditors:—

	£	s.	d.
Unsecured.			
Butler, P. E., London	122	1	0
Bridger, H. H., London	150	0	0
Bax, E. I., Weybridge	138	7	0
County of London and Brush Provincial Co., Ltd., London	48	16	0
" " "	18	2	1
Davy, W. J., Croydon	134	7	0
Fanta, F., London	38	6	7
Gabriel & Angenault, London	17	16	3
Hunt, Barnard & Co., London	14	2	0
Howard & Jones, London	63	14	8
Mining World, London	21	0	0
Milne, C. W., London	295	0	0
" "	207	10	6
Priddell & Heppell, London	10	19	0
Sharpe, Primm & Co., London	86	0	7
Stirling, S. D., London	53	0	7
" "	75	0	0
French creditors	514	17	10
Spanish creditors	296	11	6
Other Liabilities (to rank).			
Sharpe, Primm & Co, London	40	0	0
Preferential Creditors.			
Holborn Corporation	14	7	6

Schmidt Superheating.—Plants to work with highly superheated steam on the Schmidt system are being supplied by Messrs. Easton & Co., or their licensees, to the central electric stations at Bournemouth, Pembroke, Guildford, Bexley Heath and St. Pancras. The plants delivered or on order since this company took up the license under the Schmidt patents in February, 1901, are now in excess of 50,000 H.P.

What Our Consuls Say.—*Belgian Telephones.*—The gross receipts from the telephone system of Belgium for the year 1901, according to a recent report on the finances and trade of that country, were £183,070, or an increase of £12,627 on the gross receipts of the previous year.

British Honduras.—Mr. P. C. Cork, the Colonial Secretary of British Honduras, in his report for the year 1901, directs attention to the resources of the Colony, which, he states, are so considerable that it is marvellous that much greater development has not taken place. But, he points out, before the Colony can be expected to thrive as it ought to do, it will be necessary to facilitate transport by improving the navigation of the rivers and by making good roads and tramways, and establishing communication by telegraph and telephone. Mr. Cork thinks that the cost of providing and keeping in good order adequate and suitable means of communication might be borne out of surplus revenue, and he concludes his report thus:—"Persistent and sustained effort for a few years on a settled plan would make British Honduras a prosperous Colony. The most urgent need of the moment is the presence of a few intelligent men with moderate capital, having a knowledge of tropical agriculture, the determination to succeed, and the wit to make use of the natural resources to their hands."

Siam.—Consular-Assistant Carlisle (Bangkok) makes some rather scathing remarks concerning the local telegraph service in his report on the consular district of Bangkok. He states that "the condition of the telegraph line to Chiengmai is discreditable to those responsible. A telegram recently took a month to come from Chiengmai to Bangkok. The line has been a continual cause of complaint for years. The distance between the two towns is only some 400 miles as the crow flies, and no effective measures have been taken to keep it in something approaching working order. At present it is useless to pretend that Bangkok is in telegraphic communication with Chiengmai." Mr. Carlisle goes on to say that the cable from the anchorage at Koh-si-Chang to the mainland has not been repaired, or rather re-laid, yet, and the lack of it causes considerable inconvenience to the Bangkok shipping trade. The post and telegraph department generally, he remarks, has given rise to many well-founded complaints from merchants and others during the year. Of the tramways and the electric lighting of Bangkok, which are now run by the Siam Electricity Company, a Danish concern, he has, apparently, a better opinion, for he states that both systems are worked from the same power station, and some 5½ miles of new tramline was opened during the past year, which is doing extremely well, while further extensions are talked of. Electric lighting, Mr. Carlisle reports, is now general in Bangkok, as well as in mills, public buildings, and private houses, and on the roads. There has been, he states, a considerable demand for electric ceiling fans, which are being supplied to most of the chief buildings and many private residences. The Palace has recently given an order for between 40 and 50 of the fans, which are supplied from America. The import of electric goods and apparatus for the year 1901 was valued at £15,654. Of that amount £9,037 was from the United States, £5,086 from the United Kingdom, and the balance, £531, from Germany and Singapore.

Japan.—The engineers of Japan have not been slow to recognise the superiority of electricity over steam-power, and according to the report of Consul Forster on the trade of Nagasaki for the year 1901, the enlightened proprietor of the Mitsu Bishi Dockyard and engine works has spared no expense in obtaining tools and machinery of the latest and best patterns. During the past year a new machine shop, 200 ft. in length, was erected and fitted with four cranes—one of 20 tons capacity—and 35 machines of the newest pattern, all driven by electric power. The boiler shop has also been enlarged, and an overhead crane of 40 tons capacity installed, and in accordance with the proprietor's scheme of improvements, steam-power is being gradually discarded in favour of electricity. To meet the increasing requirements of power, the station at the engine works has been enlarged and a new one erected at the shipbuilding yard, the latter having at present 21 motors, of an aggregate brake horse-power of 367. The foundry shop has been enlarged, and a saw mill fitted with vertical saws, planing machinery, &c., erected, all the machinery in the latter having been imported from the United Kingdom. The total import of machinery into Nagasaki during last year showed in the aggregate an increase of £15,371 over that of 1900, the preponderance of British trade being most marked in this item. Cranes and drilling machinery were imported from the United Kingdom to the amount of £12,314 and £4,052 respectively, no other country sharing in the import of those articles. Under the head of miscellaneous machinery, the share of the United Kingdom was £36,519, that of Germany and the United States being £1,030 and £2,107 respectively. In fact, the entire trade in metals and machinery is practically in the hands of British producers, and although Germany and Belgium have a small share in the metal trade, the competition of the United States, which at one time appeared to be assuming formidable proportions, has almost entirely died out.

Finland.—Consul Cooke, in his report on the trade of the Grand Duchy of Finland for the year 1901, states that the town of Tammerfors—the "Manchester of Finland"—has, perchance, never even been heard of by the great majority of Englishmen, yet it is a striking and deeply interesting locality, having been practically founded by a Scotsman named Finlayson, who settled on its wild shores, and put to practical use its vast waterfalls some 80 years ago, when he strove to found the now immense mills which bear his name. These establishments employ about 4,000 workpeople, and the various mills are lighted entirely by electricity, derived from the waterfalls. There are about 5,000 lamps, and the machinery for the same is supplied by the Finnish Electric Light Company, who have their principal office at Helsingfors. Besides the Finlayson establishments, this company has also provided the municipality of Tammerfors and the little town of St. Michael, together with the well-known Putilov Works in Russia, with electric light, &c.

Italy.—Consul Morgan, in his report on the Consular District of Rome for the year 1901, expresses the opinion that manufacturers of electric machines and appliances, cycles and motor cars, by sending a smart representative to Italy, might secure fairly remunerative orders. The system adopted by some British firms of trying to push their trade in Italy by means of local agents, Mr. Morgan thinks, may be recommended only after a personal visit of one of their representatives, who, after completing a tour round the district, and studying local requirements, should start the agency, and not depart until it is in good working order. The proposed electric railway from Rome to Naples, Mr. Morgan reports, has given rise to interminable technical discussions, but, he remarks, judging from the large number of firms who have applied for the concession, the scheme of linking two important centres like Rome and Naples by means of an electric railway seems not only feasible, but worth undertaking. There is a large traffic of passengers and goods between the two towns, and the intermediate villages would greatly benefit. Passengers landing at Naples on their way to Rome, it is stated, would save three hours by taking the electric train. The railway company that runs the trains from Rome to its suburbs, such as Frascati, Marino, Porto d'Auzio, &c., has submitted to Government a scheme for the electric transformation of its system. The building of several independent stations for these electric suburban lines is included in the scheme, and proposals have also been made to utilise the electric trams in Rome for the conveyance of passengers to the stations. It is estimated that the scheme will involve an expenditure of £240,000.

Catalogues and Lists.—Messrs. Holden & Brooke, Ltd., have issued some new lists showing neatly prepared illustrations of their various steam specialities.

The International Electric Co., of Redcross Street, E.C., have published a new illustrated catalogue of their numerous electric light and power accessories and materials. The list consists of

just on a couple of hundred pages, most of them being well illustrated. Among other features we notice the "Plane" all-china switches, specially designed for high voltage, main and branch switches, Edison universal cut-outs, lampholders, wall plugs, fuse and switch boards, Simplex conduits, electric light fittings, such as brackets, suspensions, pendants, reflectors; weather-proof porcelain fittings for ships, collieries, and so forth; portable testing and controlling instruments, fans, and so on.

An advance proof of a new illustrated pamphlet of telephone instruments and apparatus, which is being issued to the trade, has come to hand from the Berliner Telephone Manufacturing Company, of Queen Victoria Street, E.C.

The Dowsing Radiant Heat Co., Ltd., have issued a new price list of their well-known patent luminous electric radiators. A number of the Dowsing radiators were supplied for use on the Royal yacht.

The Sun Fan Co., Ltd, of Bradford, has sent us lists of belt-driven and electrically-driven fans. We understand that the firm's motors are specially designed, and are made entirely at their works; they are neat and compact in appearance, and are made to comply with a severe specification, the insulation resistance being not less than 3 megohms, and the temperature rise not more than 70° F. after 6 hours' run at full load for the ventilated type. Starting and regulating resistances are also standardised, and the motors can be supplied separately. The fans are made from 12 in. to 12 ft. in diameter. We are gratified to find that a British firm is making such a determined effort to secure a share of the trade in electric fans, which has so long been largely in the hands of foreign manufacturers.

Mr. G. F. Zimmer, of 82, Mark Lane, E.C., has sent us a pamphlet relating to the swinging conveyor, which was shown in action at the Tramways Exhibition. The peculiarity of this machine is the ingenious manner in which, thanks to the sloping springy supports, the swinging trough is enabled to carry materials of any description, while the working parts have only three bearings.

Messrs. R. W. Blackwell & Co., Limited, of City Road, E.C., have sent us an advance catalogue of Atlas engines and boilers, for which they are now the sole agents in this country. We note that the line of goods manufactured by the Atlas Company covers not only Corliss engines of any power, but also a small line of goods comprising plain slide-valve engines and automatically-controlled engines. The automatically-controlled engines have a special feature in their shaft governor, which by means of its construction is claimed to render the regulation practically perfect, and the economy obtainable is said to be about 25 per cent. greater than that to be obtained from a throttling engine. With these catalogues we have also received a price-list, at the end of which is a useful table showing the horse-powers obtainable from the different size engines with varying mean effective pressures and speeds. There is also a table showing the mean effective steam pressures with different initial pressures and points of cut-off, and by using this table in conjunction with the other table it is possible easily to find any size of engine which is required to develop a certain horse-power. Messrs. Blackwell have adopted this method in order to put their customers in a position to themselves fix on any size of engine which they require, because, as all engine builders know, the majority of inquiries contain insufficient information owing to the customer not saying at what speed and boiler pressure he requires the engine to work.

The Lahmeyer Electrical Company, Limited, have forwarded us a copy of their pamphlet showing and describing single and multiphase generators for direct coupling.

Messrs. John Hudson & Co., of 11, Queen Victoria Street, E.C., have issued a new circular regarding their manganesite paste for steam, water and gas joints, and a copy of it containing a number of testimonials from various classes of manufacturers will be sent on application.

Trade Announcements.—We understand that the business of Joseph Sankey & Sons has been formed into a limited liability company mainly for family reasons. The whole of the ordinary shares in Joseph Sankey & Sons, Limited, are retained by the partners in the late firm, who will continue to manage the business as heretofore.

Owing to increased British business, the publishers of the *Canadian Electrical News* have established a branch office at 22, Great St. Helen's, London, E.C.

Messrs. Baxter & Cauuter, the London agents for the Newton Electrical Works, Ltd., the Electric and Ordnance Accessories Company, Ltd., the Premier Electric Lamp Co., and the British Insulated Wire Company, Ltd., notify their removal from 5, Macclesfield Street, Shaftesbury Avenue, to 86, Charing Cross Road, where they will in future hold a large stock.

The fire which occurred at the works of the Simplex Steel Conduit Co. last Friday, should occasion practically no inconvenience to the trade, as energetic measures were taken to prevent delay in delivery of Simplex material. The outbreak was confined to one department only, thanks to the prompt action of the Birmingham Fire Brigade.

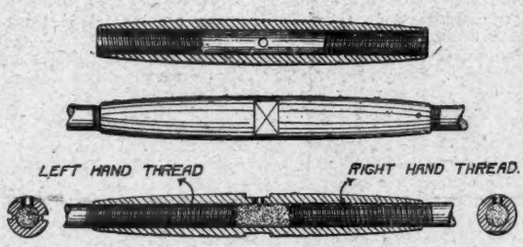
Messrs. Wm. Robinson & Co, Ltd., manufacturers of stamped steel enamelled hollow ware, whose head offices are at Wolverhampton, have opened new offices and showrooms at Finsbury Pavement House, E.C., where Mr. Charles F. Robinson will represent them as London manager, and hold a complete range of samples.

The London Electrical Fittings Co., Ltd., who have been established under that name for the past eight years, wish to draw attention to the fact that their workshops and only business premises are at Roberts Works, Hampstead Road, N.W. They are in no way connected with a firm of fittings manufacturers which lately commenced business under a somewhat similar title in London.

In re Hands, Limited.—In further reference to this matter the managing director of the company asks us to publish the following copy of circular which is being sent out to the trade:—"Gentlemen—We beg to inform you that an agent has been appointed on behalf of the debenture holders of this company, and will remain here until their claims are satisfied. We trust, therefore, that you will kindly continue to favour us with your esteemed orders and inquiries, which will at this especial time be most acceptable and receive our best attention. We trust under the circumstances you will continue your kind support."

The Affairs of an Electrical Company.—The Secretary of the British Power, Traction and Lighting Company, Limited, Hull Road Works, York, writes to us as follows under date September 19th, 1902:—"As some of the creditors of the company, more especially those for amounts under £10, do not appear to have heard what took place at the meeting of creditors held on the 25th ult., I am instructed by my directors to write to you and explain shortly the state of affairs. At the date of the meeting (the 25th ult.) a large debenture holder had commenced proceedings for the appointment of their own nominee as receiver, which would practically have meant immediate stoppage and a forced realisation, and the creditors would have been left with nothing after satisfaction of the first and second debenture holders. These proceedings were opposed by the solicitor to the company, as it was felt that it was of vital importance to the creditors, and after them the shareholders, that everything should be done to keep the business of the company going, on which largely, if not entirely, depended the carrying through of the arrangements which the directors had on foot with regard to the provision of fresh working capital to the company. The directors had come to the conclusion that the person who could best fulfil the appointment if it had to be made must be in a position and willing to take upon himself the continuance of the business as a going concern, and assist as far as it was necessary with means wherewith to carry on such business without any break. The debenture holders, who refused to delay their action, have given way to the extent of consenting to Mr. H. Watkins being appointed receiver and manager for the time being, so it is hoped that everything will now work through for the end desired by creditors and shareholders alike, and which was so clearly expressed by them at the meeting. The directors wish the creditors to be in possession of all the facts of the case, and would therefore take this opportunity of explaining the latest development of the financial situation."

Trolley Wire Emergency Joint.—The following figures show a patent sleeve or muff for rapidly and cheaply repairing broken trolley wires. All that is required is that the tower wagon be provided with a supply of these and a right and left-handed screw plate; on arrival a thread is screwed on the broken trolley wire ends, and these are coupled together by the sleeve, tightening the latter up with a spanner, squares being provided on the sleeve if desired. Solder can afterwards be run in through the



hole provided, and shown in the sections. The squares should be left in a side position in order not to interfere with the free running of the trolley wheel on the under side. The device, we believe, is the invention of Mr. H. N. Thomas, of the Huddersfield Corporation Tramways.

We presume that a convenient tool would be employed to pull up the wires, and prevent the two ends from rotating while the sleeve was screwed on. Although it is somewhat difficult to cut a good thread on copper, the device appears to be well adapted for its purpose, and could probably be left in position for a long period if necessary, until a convenient opportunity was found for permanent repairs to be effected. We commend it to the notice of tramway engineers for trial.

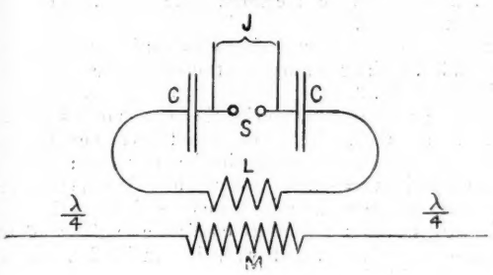
Edinburgh.—Arrangements are practically completed whereby the Caledonian Railway Company will obtain from the Corporation the electricity for lighting and power purposes for the new Princes Street Hotel and for the station and the goods yard. The consumption will amount to about half a million units per annum. Hitherto the Caledonian Railway Company has had a private installation, but that will now be abandoned. The North British Railway Company also obtains its supply of electricity for its station and hotel at the other end of Princes Street, from the city supply.

WIRELESS TELEGRAPHY SYSTEM OF PROF. BRAUN AND SIEMENS-HALSKE.

By EMILE GUARINI.

The system of wireless telegraphy invented by Prof. F. Braun, of Strasburg, and worked by Messrs. Siemens and Halske, of Berlin, consists essentially in the use of a closed-circuit oscillator, which may, by a proper choice of self-induction and capacity, be adjusted to a strictly determined period of oscillation in either direct or indirect connection with an open-circuit resonator. In this way one obtains a transmitter that sends out waves of an exact and known length only, and a receiver that responds far better to this particular length of wave than to any other. In order to make the intensity of the waves as great as possible, one endeavours to obtain exact symmetry between the circuits on either side of the resonator. This symmetry is observed in the transmitting as well as in the receiving apparatus, so that in this system there is no need for a ground connection such as is required in all other systems. The abolition of the ground connection is of great importance, as in this way one avoids practically all atmospheric disturbances; this fact has been confirmed by experiment.

Fig. 1.



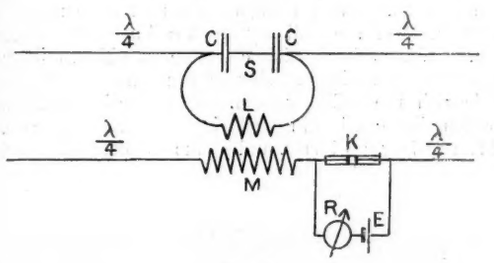
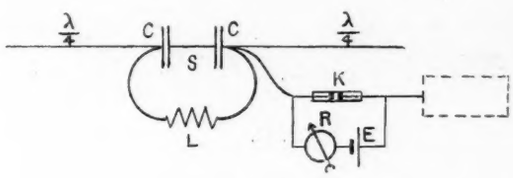


Fig. 2.

To explain the principles of the system in general, in fig 1, S is the circuit of oscillation, which is connected to the secondary terminals of an induction coil J, and excited by it It consists of the capacities C C, self-induction L, and the spar gap. If E is the potential difference between the armatures



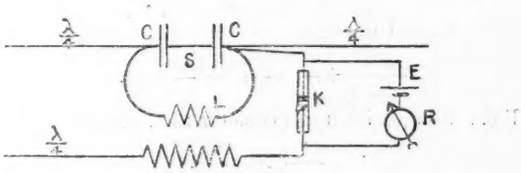


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

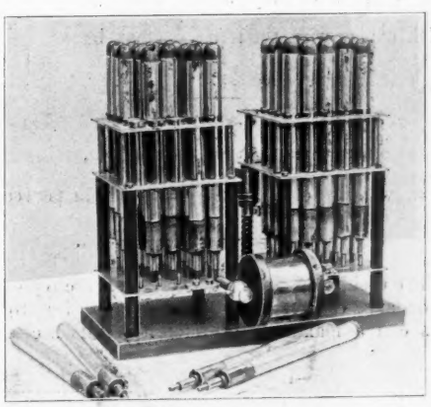


Fig. 9.

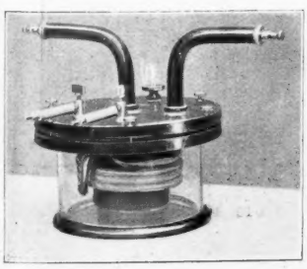


Fig. 10.

Fig. 8.

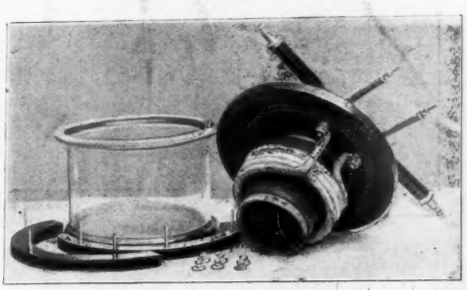


Fig. 11.

of the condensers, the intensity of current which is produced by their discharge is

$$I = \frac{E - L\frac{dI}{dt}}{R}$$

where R signifies the resistance of the circuit, and L the self-induction.

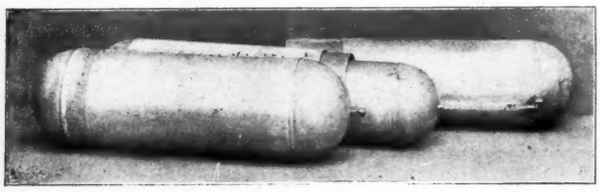


Fig. 12.

Further $E = \frac{Q}{C}$, $I = \frac{dQ}{dt}$,

and by substitution we get

$$\frac{d^2Q}{dt^2} + \frac{R}{L} \cdot \frac{dQ}{dt} + \frac{Q}{CL} = 0.$$

From this equation it can be shown that, when

$$\frac{1}{LC} > \frac{R^2}{4L^2},$$

the discharge becomes oscillatory, with the period

$$T = \frac{2\pi}{\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}}.$$

If $\frac{R^2}{4L^2}$ is very small in comparison with $\frac{1}{LC}$, which is the case in the closed circuit described above, since this consists of only a few turns of thick copper wire, the term $\frac{R^2}{4L^2}$ may be neglected; and hence

$$T = 2\pi\sqrt{LC}.$$

Also, since $\frac{\lambda}{T} = v$ (λ = wave length, v = velocity of electricity = $3 \cdot 10^{10}$ cm. per sec.), therefore

$$T = \frac{\lambda}{v} = \frac{\lambda}{3 \cdot 10^{10}} \text{ cm.}$$

The oscillations in the closed circuit are reproduced in the secondary coil M (fig. 1), and in order to obtain in this coil a maximum of intensity, it is necessary to add to each end of the coil a length sufficiently great to put this circuit in resonance with the closed circuit.

Then if the damping in the closed circuit is sufficiently small, the effect of this resonance is to raise the intensity in the secondary circuit enormously.

Experiments have proved that the length of this secondary circuit on either side of the centre of the coil M should be $= \frac{1}{4}\lambda$, which can be calculated from the constants of the closed circuit as shown above. One of these lengths becomes the aerial wire; the other may be conveniently wound into a coil, shortened to suit the increased self-induction, or replaced by a suitable capacity.

The receiver is constructed quite similarly to the transmitter, except that in a sense the connections are reversed, since in this case it is the open circuit in which the oscillations are set up, which are reproduced in the closed circuit of the secondary.

Fig. 2 shows the connections, which hardly need any further explanation.

Experiments have proved that this receiving system can be simplified, with or without the transformer, as is shown in the diagrams, fig. 3.

In these arrangements two electric lengths opposed to the aerial wire are used. In one of these the coherer is placed. It seems that the coherer disturbs the resonance; therefore the second wire A $= \frac{1}{4}\lambda$ is employed, by which the resonance is restored and the working of the coherer is assured.

The transmitting apparatus consists essentially of two groups—The induction coil with its auxiliaries, and the circuits of oscillation.

The former differs considerably from the ordinary type in construction, its aim being to produce not so much the high pressure of the ordinary spark coil as a large current output. With this special coil one is able to charge much larger capacities in a shorter time interval than was possible with the ordinary form. The practical difference in construction consists in employing a special iron core, a considerably larger primary, and a much shorter and heavier wire for secondary than in the ordinary type. In order to obtain a large charging power in the smallest time interval, the ohmic resistance of the secondary must be kept low. Further, with this construction, in which the C^2R losses are not prejudicial, we obtain an insulation more than double that of the ordinary type, so that the coil will work even in very damp places. The primary is interchangeable, and is fitted with three terminals giving different lengths of primary for different interrupters.

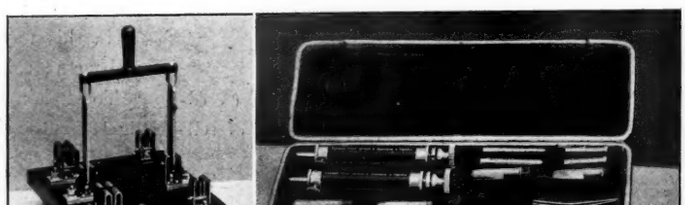


Fig. 13.

Fig. 15.

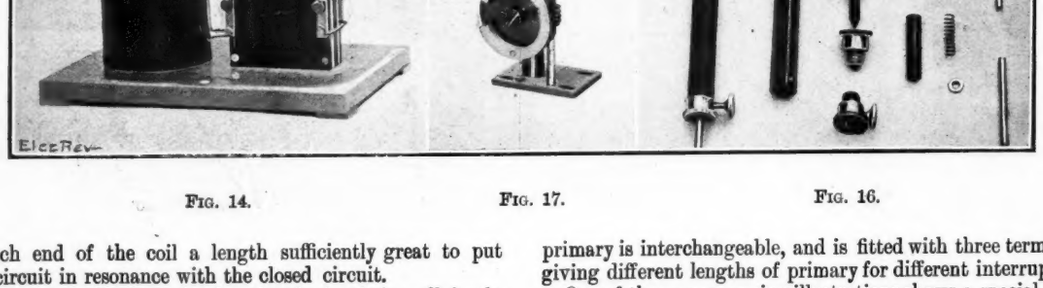


Fig. 14.

Fig. 17.

Fig. 16.

One of the accompanying illustrations shows a special form of "Wehnelt" electrolytic interrupter (figs. 4 and 5). The upper part of the platinum pole above the surface of the liquid is protected from acid vapours by enclosing it in a porcelain tube. This prevents the explosions due to sparks formerly

common. For larger distances it is intended to employ the Grisson direct-current alternating-current transformer, which may be easily employed, as the primary coil is interchangeable.

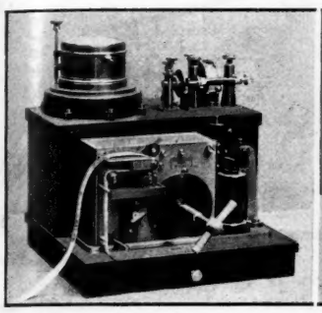


Fig. 18.

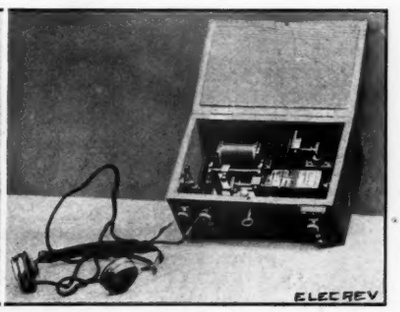


Fig. 19.

Owing to the strength of current employed the Morse key has had to be considerably altered. Figs. 6, 7 and 8 show a Morse key so modified and capable of interrupting a current of 50 amperes without damage to itself. The platinum contacts are much larger in size, and the key is fitted with a magnetic blow-out which quickly extinguishes the spark and so prevents damage to the key.

To obtain at the same time the highest resistance and the maximum capacity in the smallest possible space, the tube form of Leyden jar has been chosen. The tubes are made of the best glass, about 25 mm. in diameter and 2½ to 3 mm. thick, and their capacities vary from 0·0004 to 0·0005 mfd. each. Spare tubes are furnished with each set of apparatus, in case for any cause one or more of the tubes have to be replaced (fig. 9).

The primary of the transformer consists of a few turns of thick insulated copper wire and possesses such a self-induction that, together with the capacity described above, the desired period of oscillation $T = 2\pi\sqrt{LC}$ is obtained. The secondary coil is of such a length, size and inductance that together with the aerial wire to be employed, the highest possible resonance is obtained. As very high pressures are used (although quite harmless on account of the high frequency) the transformers are enclosed in glass cylinders containing insulating oil (figs. 10 and 11).

When the maximum resonance is obtained this transformer is a powerful multiplier (Tesla effect) and produces a high pressure, which gradually increases to the extremity of the aerial wire, where it is a maximum (Ferranti effect).

The open wire which is necessary in order to restore symmetry, is conveniently replaced by a capacity, which usually takes the form of concentric cylinders, shown in fig. 12.

A two-way switch, shown in fig. 13, is arranged to connect the aerial wire alternatively with the transmitting or the receiving system.

As such high pressures do not occur in the receiver, the condensers, fig. 14, can have much smaller dimensions than those of the sending system. The accompanying figures show the style of receiving system used at present.

The coherer, figs. 15 and 16, consists essentially of an ebonite tube containing hardened steel particles of a uniform size, in the adjustable space between two polished steel electrodes. It is not known whether a vacuum adds to the reliability of a coherer or not. At any rate, it is certain that, once an evacuated coherer loses its sensitiveness, it is of no further value. This coherer can be restored to its original condition at any time by the renewal of the steel particles.

It is well known that the coherer becomes magnetic in use, and that, while a small amount of magnetism increases its sensitiveness, too much renders it over-sensitive and hence unreliable. To obtain the advantage of a small amount of magnetism and obviate the disadvantage of too much, a permanent ring magnet is employed, fitted as shown in fig. 17, p. 544.

The foregoing apparatus is employed exclusively with the Morse inker (fig. 18). In cases where a record is not wanted, where syntonising is not essential, and for extreme distances, the inventors employ a microphone with telephonic reception (fig. 19). The microphone consists of a steel disc pressed against a carbon or steel point. By means of a screw the pressure of the disc on the point and hence the sensitiveness of the microphone can be varied at will.

From the accompanying illustration (fig. 20) an idea of the general appearance of a Braun wireless telegraph station may be obtained.

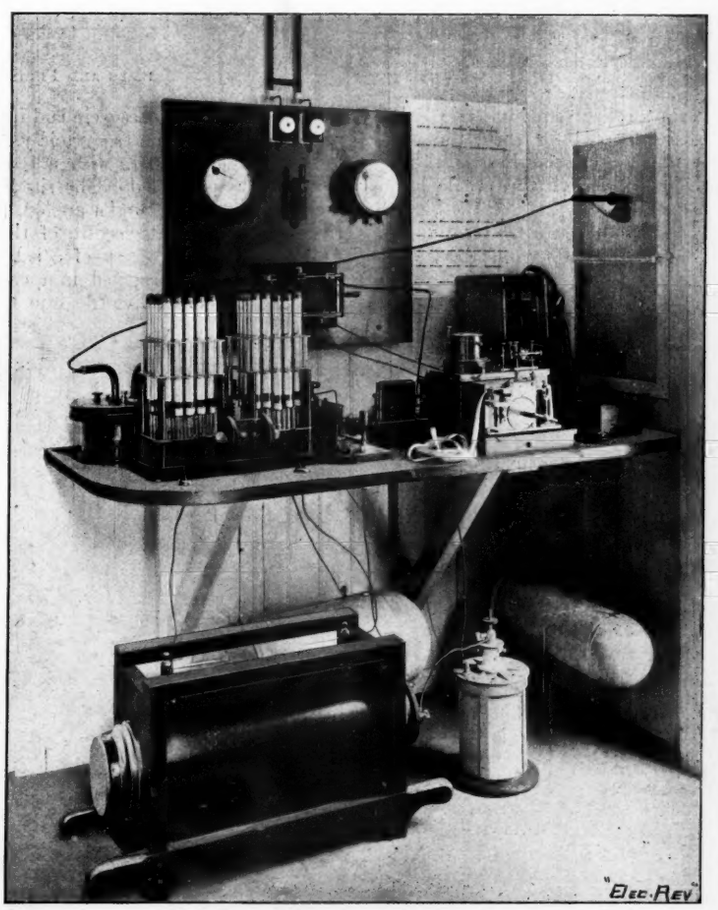
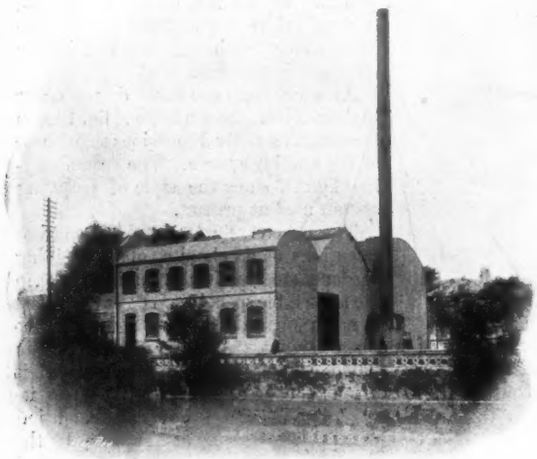


Fig. 20.—General Arrangement of Braun Wireless Telegraph Station.

The apparatus has been in use for some time for telegraphing between Heligoland and Cuxhaven, a distance of 36 miles.

STAMFORD ELECTRICITY WORKS.

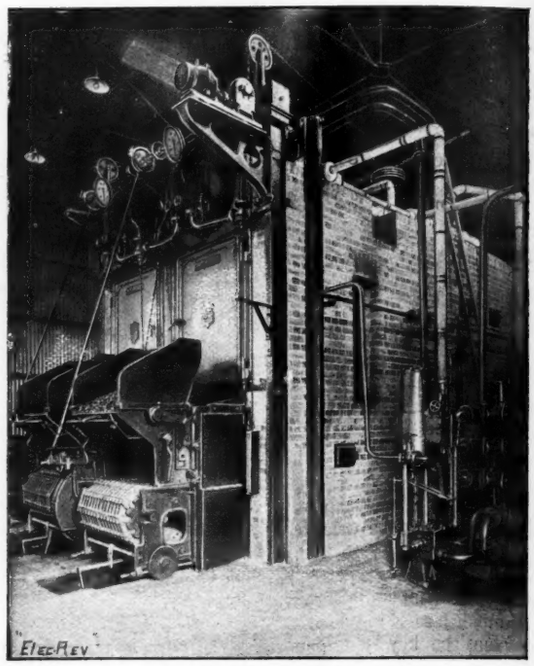
The ancient borough of Stamford—second only to Winchester in age—has been so far modernised and brought up



Exterior of Stamford Electricity Works.

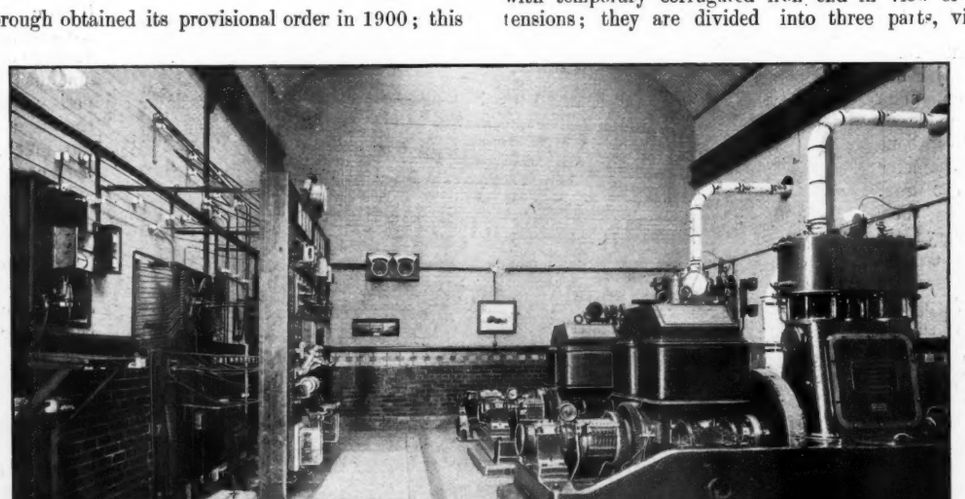
to date, that it now boasts of a flourishing electric light undertaking. Stamfordians are noted for three things—their conservatism, their caution, and their love of things ancient; indeed, these characteristics of the people have gained for the town the name of "The Town of the Sleepy Hollow," and therefore it has been no easy matter to successfully establish such an innovation as an electricity works.

The borough obtained its provisional order in 1900; this order was taken over by the Urban Electric Supply Company, Limited, and the contractors for the whole of the work were Messrs. Edmundson's Electricity Corporation, Limited. Mr. W. E. Milns was appointed clerk of the works, and since the commencement of running has acted as resident engineer. With the exception of the boilers, the whole of the plant has been erected by the resident engineer with his own staff.



Boilers and Feed Pumps.

The foundation stones were laid in October last, but the work was pushed on so rapidly, that the supply was commenced last Easter, with a total of considerably over 3,000 lamps connected. The site is in every respect an excellent one. The works are on the north bank of the river Welland, in the centre of the town, near two railway stations, and consist of a substantial brick building with temporary corrugated iron end in view of early extensions; they are divided into three parts, viz., boiler house, engine room, and battery room. The building contractors were Messrs. Hinson & Co., of Stamford.



General View of Engine Room.

The boilers, of which we give a view, were supplied by Messrs. Babcock & Wilcox, and are two in number, fitted with chain grate stokers and superheaters. The feed pumps

were made by Messrs. Hall & Sons, of Peterborough, and the feed-water heater is of the Chevalet-Boby type.

The generating plant consists of two Belliss & Morcom engines direct coupled to Parker dynamos, of 90 KW. each; Messrs. Thos. Parker also supplied the balancer-booster. The steam piping was the work of Messrs. Stewart and Menzies, of Kilmarnock, and Messrs. Carrick & Ritchie supplied a travelling crane. The switchboard was built by Messrs. Charrington, with Kelvin & White instruments. The D.P. Battery Company supplied a battery of 260 cells, with a capacity of 350 ampere-hours at 35 amperes. Additional boilers and a larger steam dynamo will be put down shortly.

The mains were laid by Messrs. Callender on their solid system. The system of supply is three-wire, with a pressure of 240 volts at the lamps.

Offices and showrooms have been taken in the town, and nearly all the 249 consumers' installations have been wired by the company. At least half the consumers are supplied through prepayment meters at the rate of 6d. per unit. Larger consumers are charged on the demand system, at 7d. and 3d. for lighting, 4½d. and 1½d. for motors. Since opening the works, applications have been received for 4,000 additional lamps; this is due, in great measure, to the energetic canvassing of Mr. R. Hill. The demand at present is very brisk, and several large consumers are about to be added. A special cable has been put down for street lighting, and it is probable that this contract will be secured next year.

We are indebted to Mr. W. E. Milne, the resident engineer, for the photographs and particulars upon which this brief article is based.

ELECTRIC LIGHT AND POWER NOTES.

Alnwick.—The Northern Counties Electricity Supply Company, Limited, has just completed an electric light installation in the ducal town of Alnwick. Close to the borders of the great Northumberland coal field, it might have been thought that the place was not one in which electric light would have been very popular, but the first reception of the light has been most satisfactory. From 2,000 to 3,000 lights have been already fitted, and there is still a large number of probable consumers waiting to see the results. The work has been very smartly done, for it was only last year that the company obtained the prov. order. The current is generated by 75-KW. dynamos by Messrs. Crompton & Co., of Chelmsford, driven by two compound three-crank engines by Messrs. Ruston, Proctor & Co., Limited, of Lincoln, which receive their steam supply from two large water-tube boilers of the Babcock-Wilcox type, fitted with mechanical chain-grate stokers; Green's economisers are installed. The switchboard is by Messrs. Dorman and Smith, of Salford. The battery room contains 250 cells divided into two batteries. The price charged is 5½d. per unit less 5 per cent. discount, or with free wiring 6d. per unit. The penny-in-the slot meter system will be adopted, under which one lamp can be lighted for 5½ hours for a penny. The work has been carried out under the management of Mr. C. W. Fairweather, the manager, and Mr. C. S. Vesey-Brown, engineer. The cabling has been done by the Callender Cable Company, under the direction of Mr. Mollard.

Ashton-under-Lyne.—On September 18th a L.G.B. inquiry into the application of the T.C. for a loan of £30,000 for electric lighting purposes and the extension of the electricity works was held. It is proposed to lay down two steam dynamos of 250 to 300 H.P., one for lighting purposes and the other for either lighting or traction, a surface condenser, with steam-driven air and circulating pumps, and mechanical stokers, with coal store, elevator and conveyor. It was stated that in 1900 the Oldham, Ashton and Hyde Electric Tramway Company paid £2,948 16s. 11d. for energy, in 1901, £4,208 11s. 8d., and in 1902, £4,514 5s. 5d.; while 1½d. per unit was paid by the Corporation to the Electricity Committee for energy for working the Ashton and Hurst trams, and additional energy would be required when the Council obtained possession of the line in the borough now belonging to the Manchester Carriage and Tramways Company. There was no opposition.

Bath.—The Somerset and Dorset Electric Power Company has approached the T.C. with respect to the supply of energy for the district.

At the meeting of the T.C. on September 17th, it was stated that it was absolutely impossible to come to terms on the basis suggested by the Electric Tramway Company's proposals for the supply of energy.

A failure of the electricity supply took place on 13th inst., due to the heating of a cross-head guide; the street lamps were extinguished for some hours, but the private lighting was only affected for a few minutes.

Brussels.—Next month the price of electricity in the Belgian capital will be reduced from 40 centimes the kilowatt-hour for motive power, cooking, heating and other industrial purposes to 25 centimes.

Canterbury.—The T.C. on September 17th decided to instal the electric light in the Sanatorium under the supervision of Mr. Blascheck.

Cardiff.—The direct current supply for consumers in the central area was switched on last week for the first time.

In connection with the opening ceremony, a report which appeared in one of the local papers on 17th inst. gave abstracts of the speeches made at the opening ceremony, which contain food for serious thought. For instance, we are told that Mr. Arthur Ellis, the borough electrical engineer, spoke somewhat as follows:—

"Was there any town in the country supplying electric light and power at lower prices than Cardiff? The committee were only charging 1d. per unit for large quantities, whereas some of the London companies were charging 9d. to 1s."

We trust that Mr. Ellis made no such statement. No London authority receives an average price even so high as 6d., and power is available in almost every district at from 3d. to 1d. per unit. Again, Mr. Ellis said (so we are told) "there was an article in the *Western Mail* of the previous day criticising the municipalisation of electric lighting. It was stated that out of a population of 164,000, only 500 were connected with the mains. That was a very unfair way of stating the case. There were not 164,000 houses in Cardiff, and each person would not require a light to himself or herself, as the case might be. The Corporation were supplying over 500 houses, and that meant, according to the Registrar-General's return, about 30,000 inhabitants. The comparison which had been made was altogether unfair."

Surely there are not 60 inhabitants in each house in Cardiff!

A curious position exists in part of the borough; the Cardiff Railway Company refuses to allow the Corporation to lay mains on its Bute Dock property in order to supply the tenants with electricity for lighting and power. At a recent meeting the chairman of the Electrical Committee stated that the South Wales E.P.D. Company could make arrangements with the railway company to lay its mains along the railway and supply the tenants in question. Certainly, if the Corporation fails to secure compulsory access to the coveted area within "a reasonable time," the South Wales Company will have the right to provide a supply.

Chester.—The T.C. is applying to the L.G.B. for power to borrow £5,924 for purposes connected with the supply of energy for the tramways.

Cordoba.—The *Review of the River Plate* says that Sr. Santiago Temple has sent in a petition to the Cordoba Government asking for permission to make use of the waters of the Rio Primero, near to the Dique Mal Paso, as motive power for an electrical power house, for supplying power for agricultural industries, rural tramways, &c.

Coventry.—The T.C. is now in a position to hire out electric motors to consumers on highly advantageous terms. Electrical energy for power purposes is being sold in Coventry at the low rate of 1½d. per unit. The following are the rates charged for hired motors:—½ H.P., £1 13s. 6d. per annum; 1 H.P., £2 5s.; 2 H.P., £2 12s. 6d.; 3 H.P., £3 5s.; 4 H.P., £3 17s. 6d.; 6 H.P., £4 7s. 6d.; 9 H.P., £5 17s. 6d.; 10 H.P., £6 15s.; 12 H.P., £7 10s.; 16 H.P., £9; 20 H.P., £10 10s.; 25 H.P., £11 17s. 6d.; 35 H.P., £14; 50 H.P., £26. Intermediate sizes are charged *pro rata*. These rates do not include fixing or wiring motors, which has to be done by the hirer.

Dorking.—The U.D.C. is to apply to the L.G.B. for leave to borrow £20,000 for electric lighting purposes. Messrs. Edmundson's will carry out the work, while Mr. Trentham is the Council's electrical adviser.

Durban (S.A.).—We learn from the *B. & S. A. Export Gazette* that the equipment of the new Natal Government Railways machine shops at Durban is being supplied by the South African General Electric Company. It includes 119 electric motors, varying from 15 H.P. to ½ H.P.; and six 300-I.H.P. steam dynamos. There is also on order a special machine to supply current at different voltages for the machine shop. At the Maritzburg machine shops a three-phase plant is being erected to supply lighting and power.

East Cowes (I. of W.).—The Electric Light and Power Company has informed the U.D.C. of its intention to lay mains, cables and boxes to supply current to the principal thoroughfares of the town.

Faversham.—A L.G.B. inquiry was held on 16th inst. by Col. A. G. Durnford relative to the T.C.'s application to borrow £24,190 for purposes of electric lighting. The Kent Electrical Power Company had offered to supply the Council with electrical energy. Mr. Talbot, the Council's engineer, estimated that the undertaking would pay with 7,500 8-C.P. lamps.

Garston.—The price of electrical energy to Garston has been reduced by the Liverpool T.C. from 5d. to 3¾d. per unit.

Germany.—The Stockach sub-station in connection with the municipal electric lighting undertaking at Stettin is to be converted into a second central station, and it is being so altered that eventually it will have a capacity of 5,000 H.P. At first two 1,000 H.P. engines are to be put down by the Kuhn Engineering Works, of Berg. They are of the vertical compound type coupled direct to Schuckert alternators.

Gillingham.—The L.G.B. has sanctioned the proposal of the U.D.C. to borrow, for the purchase of the Gillingham undertaking of the Chatham and District Electric Lighting Company, a sum of £26,659; this is only a portion of the total cost of the works.

Glasgow.—A deputation of the T.C. is to visit certain cities in England, Belgium and Germany, accompanied by the city electrical engineer, Mr. Chamen, to obtain information about large gas engines and street lighting.

Glossop.—The T.C. on September 17th decided to have all the public buildings in the town lit by electricity, and to invite tenders for wiring and fitting the premises.

Greece.—The Hellenic Government having authorised the employment of electricity as the motive power on the Athens-Piræus Railway, that company has, according to the *Levant Herald*, placed an important order for new carriages in the United States. Electricity is also to be used for lighting Athens, and a contract for the installation of electric light has just been signed between the Mayor of Athens and the Gas Company. The latter undertakes to transform 2,000 gas lamps into electric lamps, work to be begun within three months and completed within 18 months. The installation of electric light in the Stadion, Hermes and Eolus Streets, in the Constitution and Omonia Squares, and in the Haftia must be carried out before the end of February next.

Liverpool.—A Corporation Committee has been appointed to consider the contracting business of the Electric Supply Department, and to report regarding it.

Llanelly (Carnarvonshire).—Electric light has now been installed at Llanelly new docks. The plant was laid down by Messrs. Alger & Sons, of Newport (Mon.). The installation consists of 17 arc lamps erected on poles 40 ft. high, and 40 incandescent lights. The same firm has been entrusted with the lighting of the new celluloid works, Port Talbot, and the electric lighting at Messrs. Guest, Keen & Nettlefold's new works at Newport.

London.—Bermondsey.—Having secured a prov. order for supplying electricity in Rotherhithe, the M.B.C. is now going to apply for powers in the parishes of St. Olave and St. Thomas, and St. John, Horsleydown.

W.C.—An electric joint box in Shaftesbury Avenue, belonging to the Charing Cross and Strand Electric Company, took fire on Saturday afternoon through a short circuit, and a quantity of cable was destroyed.

Newton Abbot.—A proposal to introduce electric lighting has led the gas company to offer to undertake the public lighting for £698 per annum instead of £870, as heretofore. The local electric lighting company offers to supply energy at £16 per lamp per year.

Pangbourne.—The Whitchurch and Pangbourne Electric Lighting Company has notified the Parish Council of its intention to apply to the B. of T. for a prov. order to supply the district.

Radstock.—The U.D.C. on Friday last received from the Somerset and District Electric Syndicate an intimation of its intention to apply for a prov. order to supply the district.

Rowley.—The Midland Electric Corporation has given notice of its intention to lay mains in various parts of the Rowley district.

St. Helens (I. of W.).—At the last meeting of the U.D.C. it was reported that the Isle of Wight Electric Lighting Company had offered to light the western district of the town with 30 c.p. lamps, with 10 60-c.p. lamps at important corners, at £2 10s. per lamp, and that the quotation of the Gas Company was £3 4s. 6d. per lamp.

San Paulo (Brazil).—The Canadian Light and Power Co., which was organised to supply the city of San Paulo with electric light and power derived from a waterfall 34 kilometres distant, and was formally inaugurated about this time last year, has made remarkable progress in the 12 months. The amount of power supplied is now about 2,000 h.p. to 80 consumers; the number of private consumers of electric light is no less than 2,800, and the applications are coming in at an average rate of 200 per month. The cost of installation is about 15s. per lamp of 16 c.p., and the cost of running 4d. per month, with discounts of 5 per cent. to 40 per cent., according to consumption.

Southport.—The electric sub-station at the junction of Lord Street and Eastbank Street, Southport, was the scene of an outbreak of fire at midnight on Monday last week. It was found that a transformer had got on fire and was destroyed.

The T.C. decided on Tuesday night that the boulevards of Lord Street should be illuminated by 3,875 electric lamps from St. George's Place to Eastbank Street. This is the largest scheme ever debated, and in adopting it the T.C. has carried out the request both of the house proprietors and of the Attractions Committee.

Stoke-on-Trent.—The R.D.C. on September 17th decided to engage Mr. G. R. Peers, of Manchester, to visit the Council's district, and prepare an electric lighting scheme, at a fee of 10 guineas.

Tiverton.—The B. of T. has undertaken that the Council's prov. order for electric lighting shall not be revoked if some definite step to carry it out is taken before December 31st next.

Walsall.—Subject to a canvass of the districts being satisfactory, the electric light mains will be extended, at an estimated cost of £5,122.

The L.G.B. has sanctioned a loan of £1,325 for an economiser and fan.

Wolverhampton.—With the object of generating electricity for lighting and power purposes, the T.C. is recommended by a committee to erect one of Manlove, Alliott & Co.'s 8-cell destructors, with four water-tube boilers. The scheme will entail an outlay of £13,500.

ELECTRIC TRACTION NOTES.

Antwerp.—The construction of the new central power station for the working of the entire Antwerp system of tramways will, it is believed, be completed in March, and the entire system will have been electrified by the month of May. At present a temporary station supplies the current to the lines already connected. The new power station is situated at Merxem, on an area of 6 acres. The foundations for the machines are already nearly finished. The power station will contain four engines of from 1,000 to 1,200 h.p. each, three of which will be installed immediately, with triphase alternators of 700 kw. at 6,000 volts. Automatic stokers will be used. On the completion of the station—or rather the first portion of it—it will be capable of supplying 5,000 h.p., but this power can be gradually raised to 20,000 h.p., according to the exigencies of the service. The laying of the new lines of 1 metre gauge is proceeding rapidly, and the entire system will be delivered during the early summer next year.

Belgium.—The work of converting the tramway between Brussels-Midi and Forest into an electrical line, is approaching completion. It is expected to be ready for operation next month.

The International Electrical Company, of Liège, has obtained the concession of a new line of electrical tramways, which will connect Seraing Bridge with the Val-St. Lambert railway station.

The Société Nationale des Chemins de fer Vicinaux (Belgium), nearly all of whose lines are worked by steam, has now in hand a very practical scheme for the transformation of its various lines adjacent to the coast into electrically-worked ones. It should be mentioned in this connection that the Belgian Government is about to instal a couple of large power stations in the vicinity of Ostend for the production of electricity for the use of the port, both for lighting and motive power purposes. These stations would be used for the lines of the Vicinal Company, if the negotiations at present in progress between the company and the Government should come to a successful issue.

Birmingham.—It is said that tramways municipalisation will form a test question at the municipal elections.

Burton-on-Trent.—The *Stafford Chronicle* says that the Highways and Sewers Committee have, on the recommendation of their electrical advisers, Messrs. Kincaid, Waller & Manville, decided not to proceed further with the question of adopting the Lorain or other surface contact system for tramways, but to go on with the original scheme of overhead trolley wires.

Brighton.—After a long discussion the T.C. on September 18th adopted the scheme of the Tramways Committee to construct three new lines of tramways as described in the Electrical Review last week, at an estimated outlay of £37,156. A Bill will accordingly be prepared to secure powers to carry out the work.

Cardiff.—It is stated that a company has been formed to obtain powers for constructing an electric tramway between Cardiff and Penarth.

Clydebank.—The formal agreement between the burgh authorities of Clydebank and the Corporation of Glasgow, giving the latter power to extend its system to and through Clydebank, has been signed.

Dudley.—In view of the decision arrived at by the Town Council to "acquire the whole of the tramways within the borough," it may be desirable to point out that there are certain existing contracts between the Corporation and the British Electric Traction Company, which must be respected. When the company's Bill, which concerned Dudley, was withdrawn, it was agreed that the Traction Company should construct the proposed new lines to Cradley and Kingswinford, and that all the electricity they required within the borough should be purchased from the Town Council. Further, that on the expiry of the statutory occupation of the road by the company as successors to the old Dudley and Stourbridge line, the Town Council should purchase the whole of the lines within the borough, and lease them to the Traction Company for a period of 21 years. The latter part of the agreement is now being approached. No price and no rental have as yet been mentioned, but it is obvious that the adjustment of the terms of purchase and subsequent lease are matters which will require the most delicate handling.

Dunedin (N.Z.).—The *Street Railway Journal* says that Messrs. Edward Noyes and W. G. T. Goodman, of Noyes Bros., of Sydney and Melbourne, spent a few days in New York, and sailed for England on the *Lucania*, August 30th. Their visit to America was made largely for the purpose of placing contracts for apparatus for the electric tramway system in Dunedin, New Zealand, for which Messrs. Noyes Bros. have been appointed the engineers. This system is being operated by horses. It comprises about 20 miles of track, and has recently been taken over by the city from the former private owners. The rails will weigh 92 lbs. per yard, and will be supplied by the Société Belge at Antwerp. They will be laid on ties of hard Australian wood. The special work will be supplied by the Lorain Steel Company. The bonds will be of the Brown plastic type; 34 cars have been ordered from the J. G. Brill Company, and all will be mounted on the Brill 21E truck; 14 of these cars will be of the Californian type with closed body and four benches at each end; 14 will be standard box cars with 18 ft. body and 26 ft. over dashers, and six will be of the open type with 10 benches. The cars will be equipped with two Westinghouse No. 68 motors each. The poles have been ordered from the Mannesmann Works in Germany, and the construction will be partly single bracket, partly double bracket, and partly span. In the sections using the double-bracket poles, every other pole will carry an arc light. A new car house with a capacity of 52 cars has been commenced. The city is proposing to operate its line from a water-power situated some 14 miles distant from the city of Dunedin. Until this plant is completed, a temporary steam plant will be installed. The transmission will be at 15,000 volts to within two miles of the city, when the voltage will be reduced to 5,000 for transmission within the city to converter and transformer sub-stations. Connecting with the latter, a storage battery plant will be used, with accumulators of the Accumulatoren Fabrik Aktien-Gesellschaft, of Hagen. The generating station will contain two 600-KW. generators, each directly connected to a turbine, and two exciters of 25 KW. each. The electrical machinery will be supplied by the Westinghouse Company, for whom Noyes Bros. are the Australian agents.

Halifax.—The Council has approved schemes for the construction of tramways from Stump Cross to Hipperholme, and from Salterhebble to Greetland. The question whether the extension to Greetland should be by rails down Salterhebble Hill or by a lift, at an estimated cost of £12,000 and an annual expense of £1,512, is to be submitted to Sir Douglas Fox for his opinion.

Hove.—Some months ago the decision passed the Council almost unanimously to establish a municipal tramway system; the residents have now changed their mind, and considerable opposition is being organised. The residents in Waterloo Street have succeeded in getting the proposed lines in that street abandoned, also a short piece in Western Road, the old objection being brought up that all the shopkeepers in those streets would be ruined. A ratepayers' defence committee has now been formed with the sole object of opposing the scheme at all costs——if necessary, in Parliament itself.

Huddersfield.—A proposal for ½d. fares over all the tramway system has been defeated in the Town Council by an almost unanimous vote. It was stated that there was a loss of £10,000 on the tramways during 1901, without allowing for depreciation.

The chairman of the Tramways Committee (Councillor T. H. Moore) stated that next year a rate-in-aid of 3d. in the £ would be required on behalf of the tramways.

Councillor J. F. Dyson moved, in view of recent criticisms upon the report of the borough engineer (Mr. K. F. Campbell) in reference to the recent tramway accidents, that a special committee be appointed to inquire into the report and the general equipment of the tramways, and that the committee have power to engage an expert or experts for this purpose, and to inquire into the correctness, or otherwise, of the borough engineer's statement. The subject was referred to the Tramways Committee.

At a special meeting of the Tramways Committee it was resolved that, subject to terms being arranged for the protection of the Corporation, the Corporation was prepared to assist the Mirfield U.D.C. and Brighouse Corporation in securing a service of electric cars from any other source; and that the B.E.T. Co. be requested to negotiate direct with the Brighouse and Mirfield authorities, and to submit a scheme to the Huddersfield Tramways Committee for further consideration. The Huddersfield Corporation, under its Parliamentary powers, is permitted to extend the tramways to Brighouse and Mirfield, but does not seem disposed to exercise the powers.

The reconstruction of the Edgerton and Marsh sections of the system is to be proceeded with. It was resolved that the points and crossings, &c., for this work be obtained from the firms who supplied the material on the last occasion, provided the prices are the same. Cooper's patent anchor joint is to be used on the Edgerton and Marsh sections.

India.—An Indian newspaper stated that the recent introduction of electric tramways into Calcutta, and their impending construction in Bombay, have rendered it necessary to arrange for the construction of new observatories at some distance from the two cities, beyond the effects of the electric current.

An Indian exchange says that three rival companies have applied to run electric tramcars in Howrah.

Leeds.—The Tramways Committee has decided to recommend the Council to apply for powers to construct new lines from Park Lane, by Belle Vue Road and Moorland Road, to Hyde Park, 1 mile 220 yards; and from Stanningley Road, through Bramley township to Rodley, 2¼ miles; and for extensions from the York Road terminus to city boundary, 1,700 yards; from Elland Road to Sydenham Road, ½ mile; and along Great Wilson Street to connect the Hunslet Road and the proposed Victoria Road lines, ¼ mile.

Littlehampton.—Mr. Hederstedt, the representative of the B.E.T. Co., attended a meeting of the U.D.C. on September 17th with respect to the proposal to construct an electric tramway between the town and Worthing. The Council eventually went into Committee, but no definite decision was arrived at, it being arranged to discuss the proposal at a future meeting.

Liverpool.—The Tramways Committee has decided to increase the wages of electric car drivers who have been in the service of the Corporation two years, by ½d. per hour, and of those who have been three years in the service by ½d. an hour. The wages of 435 drivers will be increased by 2s. 6d. per week, and of 116 other drivers 1s. 6d. per week under this arrangement.

Longdendale.—The local authorities in the Longdendale Valley have asked the Stalybridge, Hyde, Dukinfield and Mossley Joint Tramways and Electricity Board to extend the electric tramways to their district, which is badly served with trains. The Board, however, has decided that it cannot see its way at present to incur the extra expense of such an extension.

Manchester.—The Corporation will, at its meeting on October 1st, discuss the Manchester Corporation Act, 1903. Under the proposed Act it purposes obtaining powers in regard to tramways outside the city, which are, or shall be, leased to the Corporation. Powers are also sought to lay additional tramways in various streets of the city.

Rochester.—Mr. E. Rotter has been appointed consulting engineer by the Corporation of Rochester for its proposed tramway scheme.

Rowley.—The General Purposes Committee of the U.D.C. has decided to postpone the construction of the proposed branch light railway line from Blackheath to Rowley. On the other hand, the same Committee has recommended the joint committee elected to construct the light railways from Brierley Hill through Quarry Bank to Rowley, to appoint Mr. Wilson engineer of the scheme.

Salford.—The Salford and Manchester Corporations are once more discussing the question of running electric cars over each others' lines. It is a consummation to be devoutly hoped for in the interests of public convenience.

Shipley.—Mr. Alfred Barker, manager of the West Ham Corporation Tramways, who has been appointed by the Board of Trade to decide financial arrangements between the Shipley and Bradford authorities in regard to the running of the Shipley tramways, is to hold his inquiry on Monday next. Last week the Shipley and Bradford people had a conference on the subject, but with no practical result.

South Shields.—A special meeting of the T.C. on September 18th considered a new Bill for a system of tramways in the borough. The Tramways Committee had prepared a long report, which recommended that the Council should adopt the overhead system as a basis on which to prepare the estimates for the Bill. The borough engineer's estimate of the cost of the various routes equipped for overhead traction, or for the surface-contact system, is as follows:—

	Overhead.	Contact.
1. Pier Parade to Tyne Dock	£19,920	£64,612
2. King Street to Harton Village	33,982	36,467
3. Sunderland Road to Green Street	12,807	14,982
4. Stanhope Road	17,164	19,040
5. Victoria Road	9,512	9,776
6. Hudson Street to Boldon Lane	11,635	12,430
7. Frederick Street to Stake Terrace	16,740	17,857
	£152,163	£165,194
Car sheds and lines inside	£19,000	£19,000
30 cars at £700 each	21,000	21,000
Street works £33,200 (less sale of surplus, £12,000)	21,200	21,200
	£213,360	£226,394

The borough electrical engineer submitted a report also on the different modes of traction, in which he reviewed the conduit, the surface-contact, the overhead, and the accumulator systems. In conclusion, he recommends the overhead trolley system as the cheapest, and the only one which would be a financial success in the borough. Alderman Marshall moved the adoption of the Committee's report, and pointed out that whereas the last scheme would have cost £300,000, the present one was estimated to cost only £213,000. Although that scheme was put before them, it did not follow that it would be carried out in all its details. It was the scheme they would put into their Bill, but in the carrying out, even the mode of traction might be revised, or one or more of the routes dropped. Alderman Wardle seconded the report. The town clerk said that the Harton Parish Council had unanimously decided to support the scheme of the British Electric Traction Company, who proposed to construct a line from Whitburn to South Shields, as it was believed that such a scheme would be a great convenience to the district generally. There was a good deal of discussion, and some attempts

were made to have the instructions to the Committee charged with preparing the Bill altered, but these were all negatived and the Committee's report was carried. The question of municipalisation and the mode of traction were both left over for further consideration at a subsequent meeting. The total length of routes is approximately 8 miles.

Stirling to Bannockburn.—At a meeting of the Stirling T.C. last week, the Lighting Committee reported that they had met with Mr. T. C. Darling, of Messrs. Davidson & Stevenson, solicitors, who explained that he represented the promoters of a proposed limited liability company to be formed locally for the purpose of constructing and working a trolley tramway from Stirling to the farther end of Bannockburn, with a service of cars every 15 or 20 minutes, or oftener if found necessary. After discussion and further explanation by Mr. Darling, the Committee expressed approval of the electric tramway proposal, and recommended that the Town Council inform the Bridge of Allan Tramway Company of the proposal, and ask them to meet in friendly conference with the Lighting Committee.

Sydney (N.S.W.).—The new electric tramway power station at Ultimo was formally opened on August 7th in the presence of representatives of the Railway Commissioners and of the contractors. The conversion of the remaining lines run by steam was to be begun at once.

Unsworth.—The U.D.C. has given notice to the Bury, Rochdale, and Oldham Tramway Company, requiring it to sell as much of its undertaking as is within the district, and as was authorised by the Bury and District Tramway Order, 1881.

West Bromwich.—Considerable progress is being made with the work of reconstruction and electrical equipment of the tramways, and the work is now in such an advanced state, that by the wake week—that is the first week in November—the new cars are expected to be running.

TELEGRAPH AND TELEPHONE NOTES

Cambridge Telephones.—The T.C. has appointed a Committee to consider the advisability of establishing a municipal telephone system in the City.

Huddersfield.—The Huddersfield Corporation has adopted a resolution in favour of an agreement with the National Telephone Company to lay underground wires for a period not exceeding 25 years.

Huddersfield Telephones.—At the T.C. meeting on 17th inst. Alderman J. Sugden moved, in opposition to establishing a municipal telephone service, that an agreement be entered into with the National Telephone Company for placing their wires and cables underground within the borough for a period not exceeding 25 years, subject to satisfactory terms being arranged. The motion was adopted by a majority of one vote.

New Zealand Telephones.—At the end of March last there were 23 central telephone exchanges and 35 sub-exchanges at work in New Zealand, the length of wire in use in connection therewith being 7,767 miles as against 6,987 miles at the end of the preceding 12 months.

Rochester and Chatham Telephones.—It has been decided by the Gillingham D.C. to join with Rochester and Chatham Councils in applying for a joint license in respect of municipal telephones.

Telegraphic Communication with Alaska.—Telegraphic communication has been established between the United States and Alaska. The routes of messages from different cities in the United States will be first to some point on Puget Sound. From there they will be sent *viâ* the lines of the Postal Telegraph-Cable Company and the Canadian Pacific Company to Vancouver, thence over the Dominion Government's line to Dawson. From Dawson the route will be *viâ* an American line now operating to Eagle, thence to Valdes, *viâ* a line now approaching completion. The Valdes—Eagle line which will be 400 miles in length, is to have connections with Fort Gibbons, which will be the next point on the proposed route. From there to St. Michaels a message will travel *viâ* lines now in operation. The last, and probably the most important, stretch in this long route is from St. Michaels to Nome. This distance will be covered by wireless telegraphy. When the system is completed it will be possible to send a message from Washington, D.C., to Nome, Alaska, and receive an answer the same day.

West Indian Cables.—A New York Reuter telegram reports a despatch from St. Thomas as stating that unprecedented trouble has been experienced in repairing the cables from St. Lucia to St. Vincent and Grenada. The St. Vincent section broke again on September 18th, after having been working for only two days.

Wireless Telegraphy.—The King of Italy has conferred the Cross of a Grand Officer of the Italian Order of the Crown on Mr. Marconi.

The *Times* Turin correspondent says that Signor Galimberti, Italian Minister of Posts and Telegraphs, has just had a long conference with Signor Marconi, who submitted to him a scheme for the creation of a radio-telegraphic station communicating with the stations established or to be established by the Marconi companies in London and in South and North America. This scheme will be studied by the Government and afterwards submitted to Parliament. The cost would be about 70,000 lire.

Reuter's agency learns that upon the initiative of Germany steps are being taken with a view to holding in October an international conference of the Powers interested in the subject of wireless telegraphy, for the purpose of establishing the general principles upon which an international agreement can be based. It is understood that the view held is that the practical working of wireless telegraphy being now assured, the system should, in the public interest, be made subject to rules similar to those laid down in the International Telegraph Convention.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—October 15th. Two batteries of accumulators, two boosters, switchboards, &c. See "Official Notices" to-day.

Batley.—October 10th. 240 accumulator cells and accessories. See "Official Notices" to-day.

Belfast.—October 10th. Electric motors (12 months' supply) for the Corporation. See "Official Notices" Sept. 19th.

Belgium.—October 8th. The Belgian State Railway authorities at La Bourse, Brussels, are inviting tenders for the supply of 109½ tons of galvanised iron telegraph wire, 1,800 metres of office cable, 2,000 metres of six-conductor submarine cable, 606 kilometres of copper wire, 33,000 telephone insulators, and 58,000 telegraph insulators, &c., for the telegraph service.

Bexley.—September 30th. (*a*) Transformers and pillars, condenser, air pump, water softener, &c. (*b*) Feed pumps and pipes. (*c*) Travelling crane. See "Official Notices" September 12th.

Blackburn.—September 29th. Electrically-driven travelling crane. See "Official Notices" September 12th.

Bradford.—October 2nd. Suppy of electric motors for 12 months. See "Official Notices" to-day.

Burton-upon-Trent.—September 30th. Supply and laying of electric mains, conduits, junction boxes, &c. See "Official Notices" September 12th.

Dresden.—October 1st. A competition for a safety apparatus in connection with the working of electric tramways will be decided on the date mentioned by the Communal Administration of the town of Dresden (Saxony). Three prizes of 5,000, 3,000 and 2,000 marks will be awarded.

Huddersfield.—September 30th. High and low tension cable. See "Official Notices" September 19th.

Ilford.—October 6th. Dry-back boiler, piping and condensing plant for electricity works extensions. See "Official Notices" September 19th.

Ipswich.—October 22nd. (*a*) Switchboard, motor boosters, and connections. (*b*) Overhead construction for tramways. See "Official Notices" to-day.

Maidenhead.—October 6th. Installation for the Guildhall. See "Official Notices" September 19th.

Manchester.—October 4th. Steel tramway poles. See "Official Notices" to-day.

Middlesex.—October 7th. The Light Railways Committee of the Middlesex County Council invites tenders for the construction of permanent way (for electric traction), bridge work, &c., of about 11 miles of light railways. The conditions, specification, &c., may be seen at the offices of H. T. Wakelam, M.I.C.E., county engineer, Middlesex Guildhall, Westminster.

Montreal.—The Montreal Light, Heat and Power Company, of Montreal, announce that they require about half a million feet of multiple duct conduit, and are open to receive propositions from British manufacturers therefor.

London.—October 21st. Two electric car traversers for the L.C.C. tram depôts. Specifications, &c., at Spring Gardens, £2.

N.E. Railway.—October 7th. The directors are inviting tenders for the complete electrification of about 37 miles of standard gauge line (double track mostly). For further particulars see our "Official Notices" July 25th.

Paris.—October 27th. Competition for supply and installation of motors, pumps and generators for water-works. —Apply Hotel de Ville, Paris.

Rotherham.—October 16th. (*a*) Pipes, feed pump, economiser, &c.; (*b*) switchboard. See "Official Notices" to-day.

Roumania.—The Roumanian State Railway authorities invite tenders for the installation of an electric lighting and power transmission plant in the railway workshops at Jassy.

Shanghai.—October 30th. (*a*) Two 500-kw. steam alternators; (*b*) switchboards; (*c*) two condensers and pumps. See "Official Notices" September 12th.

Spain.—September 29th. The Public Works Department, Madrid, wants offers for concession of an electric tramway between Vigo and Bayonne.

Spain.—September 30th. Spanish Post and Telegraph Department: supply and laying of submarine telegraph cable between the Spanish possession of Fernando Po and the German possession of the Kameroons.

Spain.—October 6th. Tenders are being invited until October 6th by the municipal authorities of Hulscar (province of Granada) for the concession for the electric lighting of the town during a period of 25 years. Tenders are to be sent to El Secretario del Ayuntamiento de Hulscar whence particulars may be obtained.

St. Petersburg.—November 1st (14th). The T.C. invites tenders for the reconstruction of the three town tramway lines, hitherto worked by horse traction, with electrical power, and the construction of an electric station. The terms of the tender, also application forms with particulars, will be sent free at once either by post or wire. The last date for the production of projects and offers is as above, and applications should be addressed: Stadt Amt, St. Petersburg, Russia.

Stalybridge.—October 13th. The Stalybridge, Hyde and Dukinfield Electricity Board invites tenders for Lancashire boilers, economisers, condenser and pumps, piping, crane, &c. See "Official Notices" September 19th.

Swindon.—October 4th. Section A.—Station lighting, and motor wiring; Section B.—Testing instruments and accessories. See "Official Notices" September 19th.

Swindon.—October 7th. Installations for consumers' premises for the T.C. See "Official Notices" September 19th.

Tien-Tsin.—November 30th. The Municipal Secretary at Tien-Tsin is calling for proposals for the lighting of the British concessions by electricity. See this column for August 15th.

West Ham.—October 7th. Forty-six lighting and traction poles. See "Official Notices" September 19th.

Wigan.—October 20th. (*a*) Electrical equipment of a short length of new tramway and a portion of the existing line; (*b*) construction of same; (*c*) 18 bogie cars, double-deck, four motor. See "Official Notices" to-day.

CLOSED.

Belgium.—Tenders were lately invited for the supply of the machinery and apparatus necessary for an electric lighting and power transmission plant in the new Construction Arsenal at Longue Rue d'Argile, Antwerp. The following are the tenders received:—Rue d'Argile, à Anvers: Société des applications de l'electricité (W. Dierman et Cie.), Herstal, 60,000 fr.; Compagnie Internationalé d'électricité, Liège, 64,120 fr. or 64,633 fr. or 66,283 fr.; Société Electricité et Hydraulique, Charleroi, 67,555 fr.; Compagnie Auxiliaire d'Electricité, Brussels, 72,816 fr. or 72,316 fr.; Ateliers Jaspar, Liège, 76,260 fr. or 82,260 fr.; Elektricitäts Aktiengesellschaft (Schuckert et Cie., Belgian branch), Brussels, 76,775 fr.; Maison Beer, Jemeppe-sur-Meuse, 91,140 fr. or 89,640 fr.; MM. Dutry-Colson, Gand, 91,845 fr.; Société Belge d'Electricité, Brussels, 92,000 fr, and La Société du Phœnix, Gand 95,000 fr.

Bexley.—The Hart Accumulator Company has secured the contract from the U.D.C. for the supply of a storage battery at the electricity station.

Gillingham.—The following tenders for machinery, mains and extension to the Gillingham Electric Lighting Works (recently acquired by the D.C. from the Chatham and District Electric Lighting Company) have been accepted by the Council, on the report of their electrical engineer, Mr. W. H. Trentham:—

Babcock & Wilcox (boiler)	—
British Westinghouse Company	£2,825
British Thomson-Houston Company	6,458
" " "	1,214
Henley's Telegraph Works	6,716
Messrs. James Carrick & Son	273
Mr. H. Harris (buildings)	2,870

Glasgow.—Messrs. Browett, Lindley & Co., Ltd., have booked the order for three 400-kw. sets for the Scottish Co-operative Wholesale Society, Ltd., Glasgow, and they have sub-let the dynamo portion to Messrs. Crompton & Co., Ltd.

Hampstead.—The M.B.C. of Hampstead has accepted the offer of Messrs. T. Parker & Co., Ltd., of Wolverhampton, for a dynamo for direct coupling to a 100-h.p. Willans engine.

Ipswich.—The T.C. last week accepted tenders for the electric light and tramways power station plant. The A.E.G., of Berlin, will supply the dynamos, and the engines will be of Messrs. Reavell & Co.'s make, the price of this part of the undertaking being £6,564. The time given is 28 weeks. The Tudor Company is to supply a battery for £1,256, and to maintain it for five years at £83 per annum; time, 12 weeks. Messrs. Ransomes & Rapier, Limited, will furnish the traveller for the engine room at £350, in 18 weeks. The cables are to be supplied by Messrs. Johnson and Phillips for £12,901 in 40 weeks. The permanent way and track work has been given to Dick, Kerr & Co., at £41,220, with a condition that English rails shall be used; time, six months. The arc lamp tenders have not been settled yet, pending further consideration of the advisability of lighting the streets with arcs. The buildings contract was placed with Mr. S. A. Kenny, of Ipswich, at £26,948. Messrs. Kennedy & Jenkin are the consulting engineers.

South Wales.—The South Wales Power Company has decided to instal two Bruce Peebles dynamos for direct coupling to 360-h.p. Willans engines.

Stretford.—The D.C. has accepted tenders in connection with the proposed electricity works as follows:—

Chatteris Engineering Company, for travelling crane	£145
Clayton, Son & Co., steel work for roof, &c.	1,783

FORTHCOMING EVENTS.

Monday, October 13th.—Institute of Marine Engineers "Standardising of Pipe Flanges and Flanged Fittings," by Mr. J. R. Ruthven.

SMOKE PRODUCTION.

Before the recent growth of the water-tube boiler, the smoke question had begun to assume much less proportions in London. Now, however, smoke is rampant once more. The modern type of water-tube boiler is one that had its origin in the hard coal district of the United States. The hard coal of Pennsylvania is an absolute anthracite; or, if there is any hydrocarbon in it, the quantity is so small that it cannot be perceived when the fuel is burned. It is not possible to make smoke with this coal. All its heat is generated at once, and a water-tube boiler is a suitable boiler in which to use such coal.

This boiler was introduced into this country with no provision whatever to fit it for a different kind of coal. It was made and set exactly as in America, and apparently no scientific or practical knowledge was brought to bear upon its treatment. The water-tube idea, with its tubes of small diameter, carried half-thinking theorists away. When the errors of their ways were made obvious in smoke, the fresh position was taken up that bituminous fuels could not possibly give a return from their hydrocarbon constituents, and were therefore so much inferior to Welsh coal that the latter were, in reality, cheaper. The knowledge had not then become public that in a large station it was cheaper to pay an occasional £100 as a smoke fine than to use Welsh coal at its enhanced price above bituminous, and there was no Richmond in the field.

All knowledge of the Keyham and the Wigan coal trials was conveniently ignored. It is as easy to burn bituminous fuel without smoke and with a commercial economy far superior to the results of the best Welsh, as it is to burn a paraffin lamp clearly.

No one attempts to burn a lamp without proper appliances. It is only theoretical engineers who attempt to burn bituminous fuel by means that are absolutely opposed to the chemical and physical laws which they were supposed to have learned at college.

In no electric light or power station where these boilers are worked on American lines is there anything but trouble in respect of smoke, or expense in respect of unnecessarily dear fuel to minimise the nuisance. Once set and connected up, a water-tube boiler is a costly thing to reset, and the time necessary to make radical alterations is considerable, and on this account harsh prosecutions are to be deprecated. At the same time, it is asking too much that London should be fouled and disfigured to save expense to those engineers who have been so lax or so unfortunate as to fall under the influence of the unthinking introduction of American methods. The Lancashire boiler is often held up as a better boiler to employ because in it smoke can be prevented.

It is true that the Lancashire boiler with its customary furnace arrangement is very many times superior to its rival, when this also is arranged in the customary American fashion. But it must be admitted that the water-tube boiler can be made far more certainly smokeless than the internally fired boiler.

Even in the United States, outside the hard coal region, the water-tube boiler, set in what we call American fashion, and probably the Westerners call down-East fashion, is an inveterate smoker with American soft or bituminous fuel, and some American cities—St. Louis, we believe, in particular—have local laws relating to the smoke nuisance that have been enforced with some severity.

The production of smoke is absolutely unnecessary, if prevention is undertaken when it should be, namely, before the boilers are erected. After boilers are wrongly placed, something can be done to ameliorate their behaviour—by mechanical stokers, for example, though perfect combustion is difficult to secure where the basis of the arrangement is at fault. It is not that a badly set boiler cannot sometimes be cured of smoking. There are often ways of doing so, but at the cost of the most wasteful coal combustion, and there is always a natural temptation to so arrange matters that these periods of wastefulness shall occur under the cloud of night. Darkness is favourable to fuel economy in a badly arranged furnace. What is wanted is economy with daylight, and when the public learn that this is possible, they may demand it. The common belief that what answers in one country will answer in another accounts for the many failures on either side of the Atlantic of apparatus that does well on the other. Unfortunately, Americans are, more than most people, tied to their own methods, and will not see that these are unsuited to other conditions. Boiler makers can hardly be blamed. Their business is chiefly to make and sell boilers. The fault is with those engineers who have not insisted upon the boiler makers guaranteeing to put their goods to work smokelessly and economically, or who have not seen to the matter for themselves. Knowledge of chemical laws is surely sufficient to-day to enable the demand to be made that engineers, above all others, should be familiar with such of them as lie at the very basis of the whole fabric of power engineering, in place of weakly shielding themselves behind the faulty practices imported from other conditions.

W. H. B.

NOTES.

Union is ——?—The American trades unionist is being met with in the electric wiring business of Chicago, but, judging by some remarks which appeared in a recent issue of the *Western Electrician*, his tactics are not quite so well known over there as they are on this side of the briny. Our contemporary, a few months ago, in discussing the relation of electrical workers and gasfitters in installing piping for interior wiring, presumably not knowing of the trouble that has frequently arisen here, remarked, "If the gasfitters are correct in principle, why cannot the carpenters step in and say the wireman must not bore a hole in a joist?" This was, we are told, an assumed "case of such extravagance that its absurdity would be patent to all." But our contemporary has now come across the real thing, and belabours the unions accordingly. It seems that a strike was called in the new Marshall Field retail building, in Chicago, which was the upshot of a contention between the members of two loving brotherhoods, viz., the Brotherhood of Carpenters and Joiners and the Brotherhood of Electrical Workers, as to which organisation has the right to put up moulding covering electric wires in buildings. We agree with our exchange that it is a thousand pities that such entirely unnecessary contentions as this should be allowed to interfere with needful industrial operations. It is but mere common sense that a wireman should be permitted to do his own work, which, of course, must include putting up the mouldings, and if only unions would content themselves with looking after what are really their members' interests, instead of indulging in these petty interferences and squabbles, it would be better for all concerned, unless, perchance, it be that, as a result of this internecine warfare, they cut each other's throats, and so leave the employer unmolested.

Education by Correspondence.—Special winter courses in various sections of electrical and mechanical engineering science have been organised by Prof. Jamieson, of Glasgow. Those who wish to study engineering, but are unable to attend classes, should find this system very useful; it has attained remarkable popularity in America. Particulars will be found in our advertisement pages.

Electricity Supply Statistics.—The Board of Trade has issued returns of the capital expenditure, profits, and other details relating to the working of electricity supply undertakings both by companies and by local authorities during the year 1900. The total number of authorised companies supplying electricity in the United Kingdom was 47, of which 16 were in London. It appears that "the total capital authorised at the end of the year" was £10,744,944; the "total called up at the end of the year" was £7,619,466; while the loan capital borrowed was £3,180,680. The total expended at the end of the year was £10,954,188. The total receipts during the year were £1,383,779; and the net profit for the year is given as £321,880. The return of undertakings belonging to local authorities shows that they number 165, of which 12 are in London. In most cases the figures are brought down to March 31st, 1901. The total capital expended by local authorities was £14,943,122, and the receipts for the year £1,661,760. The gross profit, "before providing for interest, sinking fund, &c.," is given as £601,032; and the profit, "after deducting expenditure on maintenance and interest on loans," as £206,453, but "after providing for interest, sinking fund, &c.," there remains a loss of £102,931.

A Misconception.—A curious incident has occurred in connection with our description of the "Omnigraph" in a recent issue. On the same page, and partly overlapping the illustration of that apparatus, was a figure showing the "Travelling Lamp" of Messrs. Laurie. In a recent number of *La Energia Electrica* we find a note regarding the Omnigraph, accompanied by *both* these figures, just as they appeared in our page; no mention is made of the travelling lamp, and the readers of *La Energia* have probably been considerably worried by the endeavour to trace the connection.

Electricity in the Navy.—It has been decided by the Admiralty to adopt the parallel system of running dynamos on board Navy ships, and that the voltage at dynamo terminals will in future be 105 volts.

Cables in War Time.—Lord Reay, the President of the Institute of International Law, has provided the Brussels correspondent of the *Morning Post* with the text of the resolutions passed on Tuesday by the Institute respecting submarine cables in time of war. They are as follows:—

"1. The submarine cable connecting two neutral territories is inviolable.

"2. The cable connecting the territories of two belligerents, or two portions of the territory of one of the belligerents, may be cut anywhere except in the territorial sea, or in the neutralised water dependent on a neutral territory (neutralised by treaty or by declaration conformable with Article 4 of the resolution of Paris, 1894).

"3. The cable connecting a neutral territory with the territory of one of the belligerents may in no case be cut in the territory or neutralised sea dependent on a neutral territory. In the open sea such a cable may only be cut if there is an effective blockade and in the limits of the line of blockade. This cable may always be cut in the territory and in the territorial sea of the enemy up to a distance of 4 miles from the 'laisse' of the low tide.

"4. The liberty given to a neutral State to transmit telegrams may not degenerate into a disloyal and manifest assistance of war given to one of the belligerent parties."

English-French Telephones.—A Parliamentary paper has just been published containing the convention regulating the telephone service between Great Britain and France, which was signed at Paris on July 29th of this year. The convention, which is signed by Sir Edmund Monson and M. Delcassé, consists of 14 articles fixing the unit adopted for the collection of charges and duration of communications—a conversation of three minutes—the scale of charges, and the duties of the two administrations to whom will be entrusted the erection and conduct of the telephones.

Personal.—Mr. A. W. Ackermann, A.M.I.C.E., M.S.I., who has been practising as an engineer and architect in Cape Colony for 26 years, the last six being in partnership with Mr. W. Adamson, as Messrs. Ackermann & Adamson, has just dissolved partnership, and is returning to England for some time. His business address is now 47, Victoria Street, Westminster, S.W.

The *Dundee Advertiser* says that Mr. George Balfour, of Messrs. Lowden Bros. & Co., Dundee, has been offered, and has accepted, an appointment with an eminent firm of electrical, mechanical, and civil engineers in London, at a salary of £1 000 per annum. Mr. Balfour is at present consulting engineer for the electric lighting of Broughty Ferry.

Appointments Vacant.—A junior assistant is wanted at Hanley electricity works, at £100 per annum; the Croydon County Polytechnic has a vacancy for the post of the head of the Department of Electrical Engineering; an assistant engineer is wanted at Luton Electricity Works at 28s. per week; a shift engineer for Paisley at 35s. per week; engineer in charge at Wimbledon at £78; and a shift engineer for Southport. See "Official Notices" to-day.

THE CENTRAL STATION ENGINEER.

Mr. A. P. Dryburgh, of Bradford, has been appointed chief assistant electrical engineer to the Dewsbury Corporation.

On September 23rd Mr. Frank Schofield, clerk to the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, was presented by the officials and staff engaged on this scheme with an oak writing table, on the occasion of his marriage. Mr. Alf. H. Gibbings, the Board's consulting engineer, made the presentation on behalf of the staff.

NEW COMPANIES REGISTERED.

W. T. Skelding & Co., Ltd. (74,817.)—This company was registered on September 8th, with a capital of £10,000 in £1 shares, to carry on the business of electrical installation and general engineers, mechanical engineers, metal workers, manufacturers of electrical fittings, apparatus and machinery, manufacturers of forgings, castings, and apparatus for electric lighting, power transmission and other purposes, &c. The first subscribers (each with one share) are:—R. Moore, managing clerk, Collis Street, Amblecote, Staffs.; Miss M. A. Moore, Collis Street, Amblecote; A. Homfray, solicitor, Brierley Hill; W. J. Cartwright, clerk, Talbot Street, Brierley Hill; Mrs. A. B. Cartwright, Talbot Street, Brierley Hill; Miss M. Walker, High Street, Cradley Heath, Staffs.; and H. Thorneycroft, agent, High Street, Cradley Heath. No initial public issue. The number of directors is not to be less than two nor more than three; the first are W. T. Skelding and G. W. W. Adams; qualification, £250.

Burn's Patent Tram Car Lifeguard Syndicate, Limited (74,856).—This company was registered on September 12th, with a capital of £2,000 in £1 shares, to acquire the benefit of all patents obtained by, or on behalf of R. S. Burn, in respect of a safety guard for electric tramcars and the like, to manufacture and deal in such guards, and to carry on the business of ironfounders, electrical and general engineers, smiths, &c. The first subscribers (each with one share) are:—R. S. Burn, 16, Caroline Street, Hull, J. A. Brown, Ashburnham, Newington, Hull, bank manager; H. Colbeck, 255, Anlaby Road, Hull, solicitor; J. W. Powell, Milton House, Hull, valuer; J. E. Walker, 18, Linnaens Street, Hull, chartered accountant; J. Watson, 101, Anlaby Road, Hull, surveyor; and C. Colbeck, 225, Anlaby Road, Hull, gentleman. No initial public issue. The number of directors is not to be less than five nor more than ten; the first are R. S. Burn, J. A. Brown, H. Colbeck, J. W. Powell, J. E. Walker, and J. Watson; qualification, 100 shares. Registered office, 12, Bowlalley Lane, Hull.

British Prometheus Co., Ltd. (74,889).—This company was registered on September 17th, with a capital of £4,000 in £1 shares, to acquire certain patents relating to improvements in electrical resistances and in the manufacture thereof, and in electric cooking, frying or roasting apparatus and heating devices, to adopt an agreement with L. M. Waterhouse, and to carry on the business of manufacturers of and dealers in electrical heating and cooking apparatus and accessories, manufacturers of electrical apparatus, fittings, machinery and accessories, &c. The first subscribers (each with one share) are:—H. Skipworth, 41, Lithos Road, Hampstead, N.W., electrical engineer; S. Crampton, 110, Cannon Street, E.C., engineer; T. W. Harvey, 18, Blewitt's Cottages, Rainham, Essex; E. Sheppard, 76, York Road, Southend, electrical engineer; C. E. Gunner, Elmbank, Kemble Road, Croydon, electrical engineer; G. H. Collins, Weybourne, Chatham Road, Kingston, engineer; and J. D. Morrison, 9, Chestnut Road, Kingston, clerk. No initial public issue. L. M. Waterhouse & Co. are the first managers.

Bray, Markham & Reiss, Ltd. (74,871).—This company was registered on September 15th, with a capital of £5,000 in £1 shares, to carry on the business of electrical engineers, contractors, manufacturers, &c. The first subscribers (each with one share) are:—E. N. Bray, Manor House, Shere, Surrey, electrical engineer; F. R. Markham, Morland, Penrith, Cumberland, electrical engineer; F. E. Reiss, Swyncombe, Henley-on-Thames, electrical engineer; S. E. A. Reiss, Swyncombe, Henley-on-Thames, gentleman; F. Markham, Morland, Penrith, Cumberland, J.P.; R. M. Bray, Manor House, Shere, Surrey, K.C.; and C. F. Lloyd, 4, Crown Office Row, Temple, barrister. No initial public issue. The number of directors is not to be less than two nor more than five; the first are E. N. Bray, F. R. Markham, and F. E. Reiss; qualification, £200; remuneration, £150 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Newcastle-upon-Tyne Electric Supply Co., Ltd., (27,997).—Particulars of mortgages and charges. On September 4th this company registered £3,400 debentures (34 of £100 each), being part of a series created on October 3rd, 1901, to secure a total sum of £250,000. Property charged: the undertaking and property of the company, present and future, including uncalled capital. There are no trustees. Total amount previously issued of same series, £127,300.

Siemens Bros. & Co., Ltd., (14,777 C).—This company's annual return was filed on June 12th, when the entire capital of £600,000 in 120,000 shares of £5 each had been taken up and paid for in full. Mortgages and charges, £150,000.

Mexico Electric Tramways, Limited (56,932).—This company's annual return was filed on July 2nd, when the entire capital of £1,000,000 in 500,000 ordinary and 500,000 preference shares of £1 each had been taken up. £1 per share has been called up on the preference, resulting in the receipt of £500,000. £500,000 is considered as paid on the ordinary shares. Mortgages and charges, £400,000.

Langdon-Davies Motor Company, Limited (55,830).—This company's annual return was filed on August 14th, when 16,100 preference and 49,274 ordinary shares were taken up out of a nominal capital of £70,000 in 20,000 preference and 50,000 ordinary shares of £1 each. £1 per share has been called up on 17,907 shares, resulting in the receipt of £17,907. £47,467 is considered as paid. Mortgages and charges, nil.

CITY NOTES.

Willans & Robinson, Limited.

The directors' report which comes before the meeting at Rugby on October 1st says that the accounts for the half-year ended June 30th, 1902, show that after writing off as depreciation of plant, &c, the sum of £4,804 4s. 10d., and paying interest upon debenture stock, the balance to the credit of profit and loss account at the end of the half-year (including £7,685 11s. 2d. brought forward) is £33,449 13s. d. Out of this the directors propose that dividends be paid at the rate of 6 per cent. per annum upon the preference shares, and 10 per cent. per annum upon the ordinary shares, amounting in all to £26,666 8s. The amount payable to directors in accordance with the articles of association, and with the resolution of October 2nd, 1901, is £919 7s. 2d., leaving an available balance of £5,863 18s. 7d. From this the directors propose to carry £475 to the reserve fund, in accordance with Article 112 of the articles of association, leaving a balance of £5,388 18s. 7d. to be carried forward. The directors are glad to state that since the date of their last report the Admiralty has ordered Niclausse boilers for two more first class cruisers (H.M.S. *Carnarvon* and *Devonshire*), making four of this class in all, and more recently, Niclausse boilers for a new battleship have been ordered, thus bearing out the previously-expressed expectation that the merits of the boiler must soon receive fuller recognition. All these boilers, aggregating (with those of two small vessels not included in the above) about 100,000 H.P., are being constructed under license from this company, pending the completion of the new boiler works at Queen's Ferry. In the directors' report, issued 12 months ago, it was pointed out that after certain writings off, there remained in the share premiums account the sum of £3,591 14s. 10d. Other later receipts from the same source raised the total sum disposable to £40,052 14s. 10d. Of this, £20,000 was carried to the reserve fund in the second half of 1901, and the following further accounts have been written off against the balance, viz., £7,431 14s., expenses of the late issues of shares and debenture stock, including the £5,000 given as a bonus on the old stock paid off, this being the condition of repayment; £193 11s. 6d., a small amount standing against some old experiments in connection with the Niclausse boiler; £2,000, on account of experimental work upon gas engines (which promises very favourable results); £1,650 9s., the final charges in connection with the removal from Thames Ditton, which is now complete; £2,504 5s. 5d., special Exhibition expenses; and a sum of £1,961 14s. 9d., being the cost to the company of a very unusual and extraordinary accident in an electric light station, which caused the entire destruction of a valuable engine, an occurrence so unprecedented and exceptional as, in the opinion of the directors, to justify its being paid for out of the fund. A balance of £4,311 0s. 2d. remains to be carried forward. The fire insurance fund of £25,000, required to be established by the new trust deed, which in the directors' opinion amply safeguards the company against fire risks, has been formed from the old debenture sinking fund and fire insurance fund.

Dick, Kerr & Co., Ltd.

The report for the 12 months ended June 30th last, to be submitted to the meeting on the 29th inst., states that the profits earned during the 12 months amount to £103,758. Out of this had to be paid debenture and loan interest and trustees' fees, and there has been reserved the sum required to provide for the premium payable on the redemption of the present debenture stock. These absorb £6,683, leaving a balance of £97,074, to which must be added the profits brought forward from last year, viz., £27,793, making a total of £124,868, which it is proposed to appropriate as follows:—In payment of a dividend of 5 per cent. per annum on the preference share capital, £6,000 (the proportion of this dividend to December 31st, 1901, has already been paid); to carry one-fifth of the remaining profits to reserve fund as required by Clause 24 of the trust deed securing the debentures, £18,215; further sum to this reserve, £21,785, making £40,000; to pay a dividend of 10 per cent. and a bonus of 20 per cent. on the ordinary share capital, which will be about £48,000; to carry forward the balance of £30,868. Since the last report important contracts have been carried out for the construction and equipment of several electric tramways both at home and abroad; and these various works have given satisfaction to the company's clients. The resolutions for acquiring the shares of the English Electric Manufacturing Company, Ltd., which were set out in the circular of July 21st last, were duly passed, and the exchange of the shares will be carried out in due course. Steps will be taken to acquire the few outstanding shares, and arrangements will be made with the debenture holders of both companies at an early date.

Official Announcements re Companies.

At the end of three months the following companies are to be struck off the register, unless good cause is shown to the contrary:—

Adams Electrical Generator Co., Ltd.
British Electric Railways, Ltd.
H. & H. Accumulator Syndicate, Ltd.
Hawley Smokeless Economiser Furnace Co., Ltd.
Middlesex and Hertford Electric Lighting and Power Co., Ltd.
Seaside Electric Laundry Co., Ltd.
Smoke Preventer and Fuel Economiser, Ltd.
Volt Electrical Co., Ltd.
West of England Electric Installation Co., Ltd.
World Gas and Electric Syndicate, Ltd.

Calcutta Electric Supply Corporation. — The directors have declared an interim dividend for the half-year ended June 30th last at the rate of 6 per cent. per annum, payable on November 15th next.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in:—Colombo Electric Tramways and Lighting Company, Limited—£120,000 5 per cent. first mortgage debenture stock. The Committee has appointed Wednesday, October 1st, a special settling day in Isle of Thanet Electric Tramways and Lighting Company, Ltd.—£150,000 4 per cent. debenture stock, and has ordered the same to be quoted in the Official List.

Folkestone Electricity Supply Co.—The directors have declared an interim dividend at the rate of 4 per cent. per annum on the ordinary shares in respect of the half-year ended June 30th last.

Direct Spanish Telegraph Co.—Dividend at the rate of 10 per cent. per annum on the pref. shares, and an interim dividend at the rate of 4 per cent., free of income-tax on the ordinary shares, both for the half-year ended June 30th, 1902, and payable on October 1st, 1902.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week.		Total to date.		Miles open.	
		Am'nt.	Inc. or dec.*	Am'nt.	Inc. or dec.*	This year	Last year.
		£	£	£	£		
Blackburn Corp. Trys. ..	Sept. 19	755	+ 3	21,834	+ 3,744	12½	13½
Blackpool and Fleetwood	,, 20	1,144	+136	16,418	— 536	7½	7½
Bristol Trys. & Car. Co.	,, 19	4,820	+691	—	—	28	28
British Elec. Trac. Co.:—							
Devonport	,, 12	601	+ 50	15,928	+ 598	5	5
Dudley—Stourbridge..	,, 12	911	+130	27,555	+ 3,588	18½	18½
Gateshead	,, 12	874	+249	26,893	+ 4,594	10½	9½
Gravesend	,, 12	234	—	1,258	—	3½	—
Greenock—Pt. Glasgow	,, 12	609	+364	18,474	+11,297	7½	7½
Hartlepool	,, 12	297	+ 24	9,507	+ 1,182	6½	4½
Kidderminster	,, 12	153	+ 18	4,633	+ 12	4½	4½
Merthyr	,, 12	204	— 33	7,452	— 1,380	3	3
Middleton	,, 12	305	—	7,793	—	8½	—
Oldham—Ashton ..	,, 12	621	+200	19,501	+ 961	8	8
Poole	,, 12	358	+ 32	9,573	— 128	33	33
Potteries	,, 12	1,628	+140	43,473	+ 2,019	28½	28½
Southport	,, 12	998	+120	9,582	+ 3,866	5½	5½
South Staffordshire..	,, 12	746	—166	26,195	— 261	21½	22½
Swansea	,, 12	536	— 6	17,489	+ 1,118	5½	5½
Taunton	,, 12	77	— 34	2 470	— 159	1½	—
Tynemouth	,, 13	426	+108	11,056	+ 1,288	3½	3½
Wolverhampton Dist.	,, 12	339	+215	6,971	+ 4,604	10½	2½
Rothesay	,, 12	201	+ 56	1,003	+ 800	—	—
Weston-super-Mare..	,, 10	289	—	4,618	—	2½	—
Central London Railway	,, 20	6,324	+451	75,887	+ 6,246	6	6
City and S. London Ry.	,, 21	2,851	+811	83,216	+10,945	6½	4½
Doncaster Corp. Trys. ..	—	—	—	716	—	5½	—
Dover Corporation Trys.	,, 20	251	— 5	8,531	+ 130	3	3
Dublin United Trys. ..	,, 19	4,706	+186	60,869	+ 105	46	46
East Ham Tramways ..	,, 20	526	+131	—	—	5	4½
Glasgow Corp. Trys. ..	,, 20	12,936	—1,022	192,455	— 8,933	56	46½
Liverpool Overhead Ry.	,, 21	1,514	— 51	19,382	— 1,199	6½	6½
Newcastle Corp. Trys. ..	,, 13	2,905	—	—	—	35	—
Sunderland Corp. Trys.	,, 21	1,120	— 14	—	—	17½	17½

* Compared with the corresponding period of 1901.

STOCKS AND SHARES.

Wednesday Evening.

Depression still characterises the markets of the Stock Exchange, and the tendency all round the House is disposed to lower prices. Consols are fluctuating to an unusual extent, and the renewed flatness of American rails increases the apprehensions which are gaining ground as to the financial stability of Wall Street and its "bosses." Home railway securities of almost every class are again steeped in pessimism, while business in industrial shares is more or less stayed pending developments in the banking worlds of both hemispheres. Nor do the mining markets add any strength to the general note of dulness, and the incidence of the new nineteen-day account is regarded with all the traditional dislike inseparable to these lengthy settlements. Moreover, the reported fresh taxation of the Transvaal is being used as a lever to depress prices. On the other hand, investors are not selling their securities. The electricity supply and the telegraph sections show this clearly enough, for prices in both are well maintained, and what is still more satisfactory, the dealers in the former market are far from complaining of any lack of business.

Several of the provincial electric lighting companies are making their dividend announcements, and this, perhaps, accounts in some degree for the improvement in this department to which attention was directed a fortnight ago. The Folkestone Electricity Supply is about to distribute an interim dividend at the rate of 4 per cent. per annum, and the price of the shares is 6, the 4½ per cent. Debenture stock being 103½, and a cheap investment. There is a mere bagatelle of the stock, £50,000 to be exact, so that to pay the annual interest, only £2,250 is required. Urban Electrics are £3 for Ordinary and Preference: there is a call pending in each case. Hove Electrics keep at 7½, while Oxford Ordinary are 5½ *ex* dividend, and the 4 per cent. Debenture Stock is par. Bournemouth and Poole Ordinary and Preference are 12½ and 10 respectively, the former carrying its dividend at the time of writing.

Brush shares continue dull, and this week it is the turn of the Preference to decline. The weakness may be due in some degree to few sales which have been made by people who did not exchange their shares for British Electric Tractions. Blackheath and Greenwich, amongst the lower-priced shares, show a small recovery, and are talked better. It is said that the company is doing much better, but the tip, let it be pointed out, is only a market one. London Electric Preference have moved up ¼, and are again at a fraction over par.

In the list of "heavy" electricity supply shares there is not a single alteration to quote, but business, as mentioned above, is fairly good, and the trade moves in both buying and selling directions, so that the market keeps in a remarkably healthy state.

Buying orders are in a majority so far as the Miscellaneous List is concerned, although quotations are practically unchanged. Nevertheless, General Electric Preference commanded 10⅜, and India-Rubber shares 21¼, both prices being over the medium. British Aluminium Preference, however, are weak, and have lost 10s., while a seller of Cromptons the other day was unable to get more than 2½, the lowest quoted price, for his shares. Willans and Robinson Ordinary are steady at 9½, the dividend declaration of 10 per cent. not affecting the price of the shares. It was generally expected that the 10 per cent. rate would be maintained. The company's report shows a balance of £33,499, besides an amount of £4,804, which is set apart for depreciation. British Insulated Wire Debenture stock is 102 to 105. Westinghouse Preference are a good market at 6½, and the Debenture stock stands at 104.

In sympathy with the rest of the unhappy home railway market, Central Londons are a trifle easier, but there is no quotable change in the official prices. Great Northern & City Preferred "A" shares are a trifle harder, and the price is back again to 8½. Metropolitan District has slipped down to 37⅜, but Metropolitan Consolidated at 85 now stands at the highest price of the current twelvemonth. It is whispered that part of the Yankee group which controls the District Company is not averse to pursuing a course somewhat similar to that which they employed when they bought up District stock. At all events, those who took advantage of the suggestion to buy "Mets" which we ventured to offer a little while ago, need be in no hurry to secure their profit.

A cloud of dense secrecy seems to hang over the arrangements with regard to the coming London to Brighton Electric Company. Those people who thought the scheme was dead have reckoned without their host, for we are able to state that active survey work will probably be started in about a week's time, and the 3s. electric service to Brighton may, after all, turn into an accomplished fact.

Globe Telegraph and Trust Ordinary have recovered from the slight dulness which beset them last week; but, apart from this improvement, and one of 10s. in Great Northern shares, the telegraph list is a little dull. Anglo-Americans are, of course, weaker upon the flatness which prevails in New York; we say of course, only because the market always puts down the stocks under such circumstances, although any violent movements should naturally assist the company's returns. There are, however, still several sellers of the Preferred stock in the market, and until a few more thousands of Anglo "B" are placed in surer hands the price is not likely to recover.

The upward movement in Telegraph Debenture stocks makes further progress. Halifax and Bermuda Cable Debentures are a point higher, attention having been directed to these by the appearance of the company's report mentioned last week. West Coast of America 4 per cent. Debentures are better to the same small extent, but there will probably come a hardening of values all round when money matters grow more normal, and an all-round rise of five points, or thereabouts, is quite likely. Despite the low prices of Consols and kindred securities, there is a dearth of good 4 per cent. investments of the gilt-edged type, and how the telegraph department has stocks to meet this demand we detailed in tabulated form a week or two ago.

Anglo-Argentine Trams are receiving a good deal of attention, and the price is better at 4⅜. For this the dividend of 2s. per share declared the other day is to some extent responsible, but the exchangeability of the shares into others of the Preference class next January has been brought into prominence the last few days, and the rise helped thereby. There is nothing new in these terms, but apparently they have been overlooked, and their recognition is causing the shares to be favourably regarded by the public. London United Tramways issues are unaltered on the week, but buying orders of Perth Electric (Western Australia) 5 per cent. Debenture stock has put the price to 103—104. Calcutta Trams are 7½, and the traction market as a whole is only moderately busy. The same remark may be applied to the telephone section, where prices are all the same as they were when we last wrote.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Sept. 17th.	Closing Quotation Sept. 24th.	Business done during week ended Sept. 24th, 1902. Highest.	Lowest.
67,100	African Direct Telegraph, 4 % Debs.	100	...	...	...	98 —102	98 —102	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	70 — 80	70 — 80	...	...
788,840	Anglo-American Telegraph	Stock	73/6	3½%	61s.	47 — 50	47 — 50	...	...
3,105,580	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	91 — 93	93½	92
3,105,580	Do. do. Deferred	Stock	£1 7s.	5s.	2s.	7½— 8	7½— 7⅝	7⅝	7 9/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5 %	3½— 4	3½— 4	...	...
19,233,300$	Commercial Cable	$100	8 %	8 %	8 %	160 —170	160 —170	...	...
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	95 — 97	95 — 97	96½	...
16,000	Cuba Telegraph	10	7 %	4½%	4 %	5½— 6½	5½— 6½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	7 — 8	7 — 8	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10½— 11	10½— 11	...	...
96,300	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	100—103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	124 —129	127½	124
1,955,565	Do. 3½ % Pref. Stock	100	...	...	...	90 — 93	90 — 93	92½	90½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	108 —111	108 —111	...	...
400,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12½— 12⅝	12½— 12⅝	12⅝	12⅝
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	107 —110	107 —110	108½	108
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104%	101 —104 %	...	...
160,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	9½— 9⅝	9½— 10	9⅝	9⅝
180,042	Do. do. 6 % Pref.	10	...	...	...	13½— 13⅝	13½— 13⅝	...	...
150,000	Great Northern Telegraph, of Copenhagen	10	12½ %	15 %	15 %	25 — 27	26 — 27	...	...
70,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	38 — 42	38 — 42	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	101 —105	101 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	2½%	...	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	⅝— 1	⅝— 1	...	...
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	93 — 95	93 — 95	95	92½
1,966,667	Do Def. Stock	100	...	60	64 xd	55 — 57	55 — 57	57	55
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	12½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 12	11 — 12	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	5	4 1/16
1,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	96 — 99	96½	...
600,000	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	102 —106	102 —106	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	5 %	6½— 7	6½— 7	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	7 %	7 %	4⅜— 5⅛	4⅜— 5⅛	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	101 —104	101 —104	...	...
15,609	West African Telegraph, Shares	10	...	...	...	3½— 4½	3½— 4½	...	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	97 —100	98 —101	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	11⅜— 12⅛	11⅜— 12⅛	12⅛	11⅜
75,000£	Do do. 5 % Debs. 2nd series, 1906	100	...	...	...	102 —105	102 —105	...	...
400,000	Do. do. 4 % Deb. Stock Red.	100	...	...	...	98 —101	98 —101	100¼	100¼
88,321	West India and Panama Telegraph	10	5%	¼ %	...	⅛ — ⅜	⅛— ⅜	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	...	...	...	3 — 4	3 — 4	...	...
40,000£	Do. do do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	99 —102	99 —102	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	...	...	...	⅛— ¼	⅜— ⅝	⅝	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	103 —106	103 —106	...	...
20,000	Brompton & Kensington Elec. Lt. Sup., Ord., 1 to 20,000	5	6 %	6 %	8 %	10½— 10⅝	10½— 10⅝	10 9/16	10½
20,000	Do. do. 7 % Cum. Pref.	5	...	...	...	10½— 10⅝	10½ - 10⅝	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 9½	9 — 9½	...	...
70,000	Do. do. do. do. 4½% Cum. Pref	5	...	...	...	5½— 6	5½— 5⅝	5 11/16	5 9/16
40,000	Do. do. "City Undertaking" 4½ % Cum. Pref.	5	...	...	...	5½— 6	4⅝— 5½	...	...
250,000	Do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	106½	...
44,436	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5½— 5⅝	5½— 5⅝	...	...
100,000£	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	109 —112	109 —112	...	...
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	4 %	0 %	5 %	9 — 10	9 — 10	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½— 13½	12½ - 13½	12⅝	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	103 —106	103 —106	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8½— 9½	8½— 9½	9	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½ - 12½	11½ - 12½	12½	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Red.	...	...	...	...	111 —114	111 —114	113	...
50,000	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	7 %	6½— 6⅝	6½— 6⅝	6⅝	...
30,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	6½	...
110,000	Do. do. 4½ % 1st Mort. Deb. Stock	100	...	...	...	107 —110	107 —110	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10½ - 11½	10½ - 11½	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1⅝— 2⅛	1⅝— 2⅛	2	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4⅝— 5⅛	4⅝— 5	...	...
950,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 — 99	96 — 99	97½	96⅛
100,000	Metropolitan Electric Supply, 1 to 100,000	10	5 %	6 %	6½%	15½ - 16½	15½ — 16½	16½	15 15/16
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —115	110 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	99 —102	99 —102	101½	...
10,852	Notting Hill Electric Lighting	10	7 %	7 %	6 %	13½ - 14½	13½ - 14½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	98 —101	98 —101	99½	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅝— 2⅛	1⅝— 2⅛	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
25,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3	2½— 3	...	...
110,000	Westminster Electric Supply, Ord.	5	13 %	16½%	10½%	11 — 12	11 — 12	11⅝	11⅛
28,141	Do. do. 5 % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year, consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Sept. 17th.	Closing Quotation Sept. 24th.	Business done week ended Sept. 24th, 1902. Highest.	Lowest.
		†							
20,000	British Aluminium 7 % Cum. Pref.	10	...	5½%	...	4 — 5	3½ — 4½	...	...
‡ 00,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	83 — 88	83 — 88	...	...
100,000	British Electric Traction	10	8 %	9 %	9 %	12½ — 13½	12½ — 13½	13½	12½
100,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ — 13	12½ — 13	12⅝	12⅝
‡00,000‡	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	125 —128	127	126½
100,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7½ — 7⅝	7½ — 7⅝	...	...
100,000	Do. do. 6 % Cum. Pref	5	...	...	...	5½ — 6	5½ — 6	5⅝	...
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	...	...	...	102 —105	102 —105	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ " " " 6 % Cum. Pref.	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Engng., Ord., 1 to 105,731	2	5½%	5 %	Nil	⅜ — 1½	1 — 1½	1 13/16	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1½ — 1⅝	1½ — 1⅝	1½	1 1/16
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	100 —103	100 —103	...	...
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	93 — 98	93 — 98	...	...
35,000	Callender's Cable Construction shares	5	15 %	15 %	20 %	15½ — 16½	15½ — 16½	16	15⅝
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅝ — 6⅛	5⅝ — 6⅛	...	...
70,000‡	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
1,860,014	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —106	103 —106	105	104½
494,093	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	105 —108	106 —108	108	106½
494,993	Do. do. Def. do.	Stock	...	...	4 %	103 —106	103 —106	...	...
1,350,000	City and South London Railway	Stock	1⅞%	1½%	2 %	72 — 74	72 — 74	72⅜	72
85,000	Crompton & Co., Nos. 1 to 85,000	3	7½%	8 %	7½%	2½ — 3	2½ — 3	2⅝	2½
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	101 —106 %	101 —106 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	1½ — 2	1½ — 2½	...	...
344,023‡	Do do do. 4 % Deb. Stock Red ...	100	...	...	...	74 — 78	74 — 78	...	...
100,000‡	Do. do 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	78 — 83	78 — 83	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½ — 2	1½ — 2	1 15/16	...
31,390	Do do 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	...	...
182,500‡	Do do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
2 ,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	5 %	5 %	10 — 10½	10 — 10½	10⅜	...
100,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	100 — 103	100 —103	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16 — 17	16 — 17	16⅛	16⅛
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½ — 5⅝	5½ — 5⅝	...	...
48,050	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20½ — 21½	20½ — 21½	21¼	...
300,000‡	Do. do. do. 4 % 1st Mort. Deb ...	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3⅜%	3½%	1½%	4⅜ — 4½	4⅜ — 4½	...	...
10,000	Do. do. Pref., £10 paid	10	5	...	...	9⅜ — 10½	9⅜ — 10½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	14½—15½	14½— 15½	...	...
	§Rosling & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/0 to 20/0	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	38 — 41	38 — 41	39½	38
150,000‡	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	102 —105	102 —105	102½	...
540,000‡	Waterloo and City Railway, Ord. Stock ...	100	3 %	3 %	3 %	90 — 93	90 — 93	92	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅛.
National Electric Free Wiring, ¾—1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref. (£10 pd.), 10—11.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, September 24th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	...
a " Nitric	per cwt.	22/-	22/-	...
a " Oxalic	per cwt.	33/-	33/-	...
a " Sulphuric	per cwt.	5/6	5/6	...
a Ammoniac, Sal	per cwt.	42/-	42/-	...
a Ammonia, Muriate (crystal) ...	per ton	£22 10	£22 10	...
a " " ...	per ton	£20	£20	...
a Bleaching powder	per ton	£7	£7	...
a Bisulphide of Carbon	per ton	£15	£15	...
a Borax	per ton	£13	£13	...
a Benzole (90 %)	per gal.	7/-	7/-	...
a " (50/90 %)	per gal.	5/-	5/6	...
a Copper Sulphate	per ton	£19	£19	...
a Lead, Nitrate	per ton	£24	£24	...
a " White Sugar	per ton	£31	£31	...
a " Peroxide	per ton	£27 10	£27 10	...
a Methylated Spirit	per gal.	2/6	2/6	...
a Naphtha, Solvent (90% at 160° C),	per gal.	5/6	5/6	...
a Potash, Bichromate, in casks...	per lb.	9d.	9d.	...
a " Caustic (75/80%) ...	per ton	£24	£24	...
a " Bisulphate	per ton	£20	£20	...
a Shellac	per cwt.	109/-	109/-	...
a Sulphate of Magnesia	per ton	£4 10	£4 10	...
a Sulphur, Sublimed Flowers ...	per ton	£6 5	£6 5	...
a " Recovered	per ton	£5 10	£5 10	...
a " Lump	per ton	£5	£5	...
a Soda, Caustic (white 70 %) ...	per ton	£10 15	£10 15	...
a " Crystals	per ton	£3	£3	...
a Bichromate, casks ...	per lb	9½d.	9½d.	...

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	...
b " Wire, in ton lots	per ton	£224	£224	...
b " Sheet, in ton lots	per ton	£191	£191	...
p Babbitt's metal ingots... ...	per ton	£40 to £140	£40 to £140	...
c Brass (rolled metal 7" to 12") basis	per lb.	6¾d.	6¾d.	...
c Tube (brazed)	per lb.	8¼d.	8¼d.	...
c " " (solid drawn) ...	per lb.	7d.	7d.	...
c " Wire, basis	per lb.	7d.	7d.	...
c Copper Tubes (brazed) ...	per lb.	8¼d.	8¼d.	...
" " (solid drawn) ...	per lb.	9d.	9d.	...
p Copper Bars (best selected) ...	per ton	£69	£69	...

METALS, &c. (*continued.*)		This week.	Last week.	Inc. or Dec.
p Copper Sheet	per ton	£69	£69	...
p " Rod	per ton	£69	£69	...
e " Electrolytic Bars ...	per ton	£68	£68	...
e " " Sheets ...	per ton	£75	£75	...
e " " Rod ...	per ton	£68	£68	...
e " " H.C. Wire	per lb.	8d.	8d.	...
f Ebonite Rod	per lb.	8/-	8/-	...
f " Sheet	per lb.	5/-	5/-	...
n German Silver Wire	per lb.	1/5	1/5	...
h Gutta-percha fine	per lb.	8/-	8/-	...
h India-rubber, Para fine	per lb.	3/2½	3/2 to 3/4	...
i Iron, Charcoal Sheets	per ton	£18	£18	...
i " Pig (Cleveland warrants) ...	per ton	53.9½	53/7½	2d. inc.
i " Forgings, according to size	per ton	From £11	From £11	...
i " Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	...
i " Wire, galvanised No. 8 ...	per ton	£9 15	£9 15	...
p Lead, English Ingot	per ton	£11 to £11 5	£11 2 6 to £11 5	dec.
p " " Sheet	per ton	£13	£13	...
m Manganin Wire No. 32	per lb.	8/-	8/-	...
p Mercury	per bot.	£8 15	£8 15	...
d Mica (in original cases), small ...	per lb.	3d. to 9d.	3d. to 9d.	...
d " " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	...
d " " " large ...	per lb.	3/8 to 7/8	3/8 to 7/8	...
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	...
p " rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	...
p " " strip & sheet	per lb.	From 1/2	From 1/2	...
e Platinum	per oz.	£4	£4	...
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	...
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	...
i " " in bars		£58	£58	...
p Tin, block	per ton	£119 to £120	£121 to £122	£2 dec.
p " foil	per lb.	1/6	1/6	...
n " wire, Nos. 1 to 16	per lb.	1/7	1/7	...
p White Anti-friction Metals — "White Ant" brand	per ton	£36 to £60	£36 to £60	...
f Yarns, 2/18s Grey Cotton, on sp'ls	per lb.	7d.	7d.	...
f " 6 lea. Flax	per lb.	5¾d.	5¾d.	...
f " 3 ply 12 lbs. Russian ...	per lb.	5⅛d.	4⅞d.	...
f " 10 lbs. Russian, single ...	per lb.	4¾d.	4¾d.	...
f " 180 lbs. Jute rove	per ton	£11 15	£11 15	...
b Zinc, Sheets (Vieille Montagne brd.)	per ton	£23	£23	...

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons, d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakespeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co., Ltd

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

BRITISH ASSOCIATION, BELFAST, 1902.

In our last issue we dealt briefly with the presidential address of Prof. James Dewar, and also with some of the points raised in that delivered in Section G by Prof. John Perry. Some further comments on Prof. Perry's very enthusiastic statements will not be out of place in view of the importance of the matters brought forward. The address had much of sound sense in it. If we understand Prof. Perry aright, he would not debar a man, who did not understand horse breeding, from riding a horse. Similarly, he recognises that we cannot all be Maxwells, but he would not bar us from the use of mathematics as a tool because we cannot know all about it. The mere mathematician would have the engineer know all about mathematics, and the engineer must then superadd engineering. This is illiberal. Engineers allow mathematicians to ride in trains and electric cars, though they may not know the difference between a commutator and a slide bar. Prof. Perry has no praise for the elaborate steam engine of the college laboratory, which is fearfully and wonderfully made, is compound, triple, jacketed, reheated, simple, or superheated in a variety of permutations and combinations sufficient to damn all experimental results that it may give. Such an engine may perhaps be studied by a student, who will never see such another, and it will unfit him for real steam engines. The Professor would stick to actualities; the actual engine is good enough to test, an old screw jack is good enough to deduce efficiencies from.

It is a little refreshing to find a man like Prof. Perry, who is not bowing down to the fetish of German methods of education. He would prefer our English methods to be English, not German, and he is right. The English people have not been led along the road to success by abstract principles, or abstract methods of reasoning, so much as have other peoples. We have learned through trial and error. Perhaps it is this very method that has made England what she is. Our temperament is of the sort which tries, perhaps fails, and tries again; in time comes success.

Trying is, in itself, no bad thing. As a nation we have tried often enough, after being apparently beaten, and have incurred Continental contempt for our folly. Educated Germans had no difficulty any time the last two or three years in showing our hopeless case, but we have muddled through. We don't want always to be muddling through, and as a nation we should endeavour to be better educated; but let it be education that we secure, and not merely information of the Hochschule type. Prof. Perry has faith in our race, because he evidently thinks the race has common sense. It is, perhaps, due to common sense that the people of Great Britain have never been led by the nose by a corrupt press along paths of error, after the manner of the highly trained foreigner.

As Prof. Perry says, when England does take hold of a business in earnest, she goes through with it thoroughly. She has not yet seriously taken in hand education on modern lines, but when she does it will be thoroughly, and it will be English and practical.

In Section A, Prof. Purser's presidential address consisted of a sketch of the Irish School of Mathematics and Physics.

The following is a list of the papers of more or less direct electrical interest which came before one or other of the sections:—

H. A. Humphrey—"Recent Progress in Large Gas Engines."
Hon. C. A. Parsons—"Steam Turbines."
Report of the Committee on Road Traction.
J. Brown, F.R.S.—"An All Stations Express."
F. J. Dick—"Water-Power in Ireland."
J. E. Kingsbury—"The Future of the Telephone in the United Kingdom."
F. Holden—"A New Magnetic Testing Instrument."
Prof. E. Wilson—"Alloys of Aluminium."
M. B. Field—"Some Electrical Instruments."
Joint discussion of Sections G and L on the Training of Engineers.
Joint discussion of Sections A and L (Educational) on the report on "The Teaching of Mathematics."
W. H. Booth—"Combustion of Bituminous Fuel."
J. S. Raworth—"The Prevention of Smoke."
W. H Booth—"The Solignac Boiler."
H. A. Mavor—"The Making of a Dynamo."
H. E. Wimperis—"A preliminary note on Gas Engine Explosions."
Hon. R. P. Porter—"Municipal Trading."
P. Ashley, M.A.—"Municipal Policy and State Control."
J. E. Petavel—"Some Experiments on Radiation and Absorption: a Preliminary Study for a Standard of Light."
Lord Kelvin, F.R.S.—"Animal Thermostat."
Dr. J. Larmor, Sec.R.S.—"On the Application of the Method of Entropy to Radiant Energy."
Dr. J. Larmor, Sec.R.S.—"The Relation of Voltaic Potential to Temperature."
Report of the Committee on Electrical Standards.
Prof. E. Wilson, F.R.S.—"Magnetic Detectors in Space Telegraphy."
Prof. G. M. Minchin, F.R.S.—"A New Receiver for Hertzian Oscillations."
Dr. E. W. Marchant—"A Graphical Method of Determining the Discharge of a Condenser through a Variable Self-induction."
H. F. Nalder—"Seamless Aluminium Tube."
J. Butler-Burke—"Luminosity and the Kinetic Theory."
Prof. J. Perry—"A note on Gas Engine Explosions."
Mr. Holroyd-Smith—"The Importance of Minor Details in Engineering Work."
W. Taylor—"The Science of the Workshop."
Prof. S. P. Thompson—"On the Specific Utilisation of Materials in Dynamo Construction."
Report of the Committee on Electrical Standards.
Prof. J. Chunder Bose—"Electric Response in Animal, Vegetable, and Metal."

On the evening of Friday, September 12th, a lecture on "Becquerel Rays and Radio-activity" was delivered by Prof. Thomson, of Cambridge, who traced the history of their discovery, and showed, finally, how all manner of objects—the leaves of trees, for example—were radio-active, so that there was hardly a piece of the earth's surface that did not contain some radio-active material. The Professor was particularly interesting in his reference to the substance "thorium," showing how portions were continually becoming active, whilst active portions were as continually becoming dead. The difficulty of lecturing on such a subject is very great. Very few of the crush present had an expert knowledge of the subject.

The Hon. C. A. Parsons's paper on "Steam Turbines," read in Section G, and abstracted below, was well illustrated with photographs of turbine vessels and installations, and some beautiful photographs of cavitation effects.

Mr. J. Brown, F.R.S., explained his working model of "all stations fast train" with pick-up and slip cars, and he also showed a new elastic or spring spoke-wheel for road vehicles, which struck us as somewhat complicated and dust-producing.

Mr. Dick's paper on "Water Power in Ireland" was to the effect that this did not exist to such a large extent as is popularly supposed.

There was also presented to Section G the report of the Committee on the Resistance of Road Vehicles to Traction, which is too long to reproduce, but to which we hope to make further reference.

THE SMOKELESS COMBUSTION OF BITUMINOUS FUELS.

By W. H. Booth, M.Am.Soc.C.E.

(Abstract of paper read before Section G.)

Engineers are taught at college that combustion can only take place in the presence of a sufficient supply of oxygen at a sufficiently high temperature.

An ordinary class-room experiment is to surround a candle flame with a coil of wire which abstracts heat so rapidly from the flame as to cause combustion to cease, and the flame is extinguished. This experiment contains the whole secret of combustion.

When engineers go out into the world, they find that the burning of coal and generation of steam are carried out upon lines which are quite opposed to the principles they were taught at college, and more upon the lines of the refrigerated candle flame experiment. They become aware that the daily practice of steam raising, while opposed to theory, is very far from good, and they are told that it is not possible to burn bituminous fuel except with evolution of smoke.

Most engineers acquiesce in this very lamentable state of affairs, and are the more inclined to do so, because, where teachers of engineering have been responsible for boiler arrangements, they are unable to find that these present any differences from the common herd. The modern steam boiler is, in fact, quite as primitive as a common pan set directly upon a fire to boil. An African savage, with a gourd as his pot, places this to boil just as scientifically as do our professors of engineering place boilers. The modern boiler maker merely sells boilers. The consulting engineer, who ought to order their setting, accepts the methods of the savage, the impossibility of which, in respect of good results, he has taught, or has been taught at college, but has not comprehended.

There are certain fuels which burn *in situ*. No flame is produced. They waste away when exposed to air, and the wasting surface becomes brilliantly incandescent. Such fuels are wood, charcoal, coke, or anthracite coal.

Because of this peculiar manner of combustion, such fuels may be burned directly below heat absorbing surfaces, and combustion will be very perfect, but even with fuels of this description, a certain mingling into one stream of all the products of a fire may be of advantage, because such a fire may be of uneven thickness, and, in places, may admit too much air, that will serve to burn the carbonic oxide that has been formed where the fire is too thick.

In other forms of fuel known as the bituminous and semi-bituminous coals, which contain hydrocarbons, the problem of industrial combustion is more difficult. In the first place a bituminous coal passes through two distinct processes when burning: first the hydrocarbons, which are volatile, are distilled off by the heat of the bed of partially consumed fuel into which the fresh coal is thrown. The hydrocarbon gases will burn with a flame of greater or less length if raised to a sufficient temperature with a suitable amount of oxygen. While they are being distilled they absorb so much heat that the solid carbon, from out of which they are driven by the heat, does not itself ignite. Its temperature is kept too low for combustion. When the hydrocarbons have been evaporated, the solid carbon begins to acquire heat from its position on the hot fire below and soon it acquires the temperature of combustion and begins to combine with the oxygen passing by and to glow with its own incandescence. Its future behaviour is simply that of the solid carbons first named.

Engineers are more concerned with the behaviour of the hydrocarbons. These, as explained, burn with a flame of greater or less length according to character and temperature.

Thus certain Welsh coals of a so-called smokeless variety burn with a short flame. This flame is short because the hydrocarbons, whose combustion causes the flame, are burned in a short space. Hence it is that, even when the boiler is placed near to the fire surface, these coals will often burn without smoke.

The long flaming bituminous coals give off hydrocarbons, either of such large volume or peculiar constitution that they require much greater space in which to complete their combustion. It is essential that this space should be of such a nature as to its surroundings, that the temperature of the burning gases shall be kept sufficient to ensure continuous and perfect combustion. If this be not done the hydrogen may, perhaps, burn, but the carbonaceous particles will be separated out in the flocculent form as soot. It seems probable that the worse the condition, the longer will be the flame up to a certain point; that is to say, if the cooling effect is

moderate, so as not to extinguish the flame altogether, this may continue many feet, but if the cooling is rapid, as when the gases are sent directly from the furnace between cold water tubes, the flame will be at once extinguished. Where the furnace is entirely of a non-heat absorbing nature, the combustion will be rapid and the flame will be reduced in length.

It seems probable that about one-fourth only of the total heat capacity is secured at the grate and the remaining three-fourths along the total path of combustion, and this path must not be cooled below the temperature proper to combustion, or there will be smoke and loss.

If the various boiler settings adopted in practice be examined, it will be found that very scant attention has been paid to the question of the continued combustion of the bituminous fuels beyond the grate. Internally-fired boilers are well arranged as regards the form of furnace, and the direction of flow of the gases over the length of the fire. Mixture of the gases is well provided for, and space is provided for their continued combustion beyond the bridge, but the arch of the furnace is water cooled, and the internally-fired boiler is thereby brought down from an easy smokelessness to a critical position of being smokeless or the reverse, according as the condition of the draught and the fire may decide. As though to render the critical position one of certain smokiness, boiler makers have long persisted in placing water pipes across the flue tubes. These baffle and extinguish the flames, and have never yet been shown to have a good effect even on evaporation. As a fact, they are worse than useless in this respect, and an incentive to smoke production, their evil effect being well seen by comparing the condition of the flues in Lancashire boilers with and without these useless encumbrances.

There is considerable difficulty in lining the furnace of a Lancashire or other internally-fired boiler with fire-brick so that the water-cooling effect may be prevented, because the lining would so much reduce the furnace diameter. This, however, should prove successful.

The simple form of water-tube boiler, consisting of a number of inclined tubes, is set directly over the fire-grate. From every square inch of the grate surface the gases of combustion rise vertically upwards, proceed at once between the tubes, and combustion is promptly extinguished. Here, even if given draught and a sufficient total air supply, smoke is inevitable. First, there is no general sweeping action of the gases over the whole grate area, and there can be no mixing of volumes containing too much air with volumes containing too little. This is the fault of all boiler furnaces where the gases rise vertically from the grate. In the short distance from grate to water tubes, even a short flaming Welsh coal will not always sufficiently complete its combustion as not to smoke.

Yet the ordinary water-tube boiler lends itself exceedingly well to a smokeless setting. In the first place, the grate requires to be arched over with a fire-brick arch occupying the place of the lower row of tubes. The boiler itself requires to be raised about 4 ft. higher than the usual position, and the gaseous products of the furnace having been compelled to sweep over the length of the fire, are turned back under a second arch which springs forward from the back wall of the furnace and a large combustion chamber is thus formed, entirely surrounded by fire-brick lining, whence the now perfectly burned gases escape to the water tubes. Admission of air above the fire appears to be essential, as was pointed out by Wye Williams years ago. Thus the water-tube boiler, hopelessly smoky in its usually accepted form, can more easily be made certainly smokeless than can the usual forms of internally fired boilers.

The usual form of water-tube boiler and its setting, so blindly adopted by electrical engineers, had its origin in the anthracite burning localities of the United States. Pennsylvania anthracite is so entirely carbon that it will produce no smoke under any conditions. In another form of American water-tube boiler, which is an outcome of more Westerly or soft coal areas, the setting is different, and involves more or less fully the conditions above described as necessary. This shows the influence of environment, while the failure here of the anthracite mode of boiler setting again points to the absurdity of attempting to employ American methods outside America, without proper consideration of the facts involved. The smoke nuisance from water-tube boilers has been so great that the fault has been laid on the principle of water tubes, whereas it is simply a fault of improper brick settings.

The small tube boiler may be similarly considered. Here again is ordinarily found a large fire grate from which the gases rise directly amongst the tubes. The furnace is approximately triangular in cross-section, the grate forming the base and the two sides being formed by the sloping walls of cold-water tubes. Such a boiler must inevitably produce smoke, for there is no mixture of gases and no attempt to conserve temperature to the period of total combustion.

In the boiler of Mr. Jas. Weir, without any increase in the breadth of the boiler at the ordinarily widest part—the grate level—the tubes have been differently spread so as to form the usual triangular furnace by means of a single row of tubes only, and between this wall of tubes and the main body of tubes, space is formed to give a fairly commodious combustion chamber. Both the walls of single tubes and the first rows of the main body of tubes are enveloped in fireclay blocks in order that the boundaries of both furnace and combustion chamber shall be of non-heat absorbing material. The gases which rise from the furnace have to pass over the top edge of the furnace wall in order to enter the combustion chamber in which their flow is downward, so that they may escape among the tubes by passing below the edge of the second fire brick wall. The products of combustion are then doubled back on themselves in entering the combustion chamber, and a mixing action is secured similar to that in the long furnace of the internally fired boiler; the correctness of the principle is demonstrated by the smokelessness of the Weir boiler, and it is very interesting to watch through the sight holes provided for the purpose the clearing effect of the above-fire air admission.

Smoke represents loss of fuel, but in the ordinary boiler furnace its prevention can only be secured by the employment of so great an excess of air that loss ensues, and usually the best results are obtained from a boiler when smoke is allowed. With a refractory lined furnace a high temperature is secured, and the flame of bituminous coal is shortened, so that even the long-flaming coals appear to complete their combustion within a few feet of the fire.

Where a bituminous coal is seen to produce flames extending 60 or 80 ft. round the flues of a Lancashire boiler, this must not be taken to indicate the impossibility of smokelessly burning such coals in a proper furnace and combustion chamber of comparatively short length. The very long flame simply indicates that the cooling effect of the boiler plates has served to prolong the flames, but has not been sufficient to cool them to the point of extinction. Higher temperature would shorten the period of combustion.

The general correctness of the principles enunciated is exemplified in the locomotive. Though surrounded with cold plates, the sharp draught of the locomotive boiler causes the production of a high fire-box temperature, but the gases from the grate pass so directly into the cold tubes that the locomotive form of furnace is a very smoky one.

But an arch of firebrick is thrown across the box from side to side, springing from the tube plate below the lowest tubes, and compelling all the products from the grate to travel round the higher edge of the arch, meeting a stream of fresh air entering at the door and completing combustion in the upper half of the fire-box. The path to the cold tubes has been greatly lengthened by the arch, and the gases have been made to travel together and mix with air; the result is more perfect combustion, and a well-managed locomotive does not smoke when running under draught.

Though for years all this evidence has been before engineers, it has apparently had no effect with the boiler arrangements of almost all modern power stations. First, the badly set boiler is laid down, then follows the period of smoke and fines, and the aid of mechanical stokers, of steam blowers, and other palliatives is sought in mitigation of the evil. Some of these things introduce other evils, notably loss of economy, as noted above. Others, as mechanical stokers, which might be very successful under properly set boilers, fail under badly set boilers, and gain a bad reputation undeservedly.

The whole trouble is, of course, in faulty initial design. The one object of modern practice seems to be the crowding of heating surface closely upon the fire, to the entire neglect of the production of the heat it is sought to utilise.

If the many unsuccessful attempts to prevent smoke when burning bituminous coals be examined, it will be found that they fail on the point of temperature. Air admission and the mixture of the furnace gases has been frequently tried, but has failed wholly or partially because of lack of temperature. Forced draught has more or less remedied many cases, because it has helped to create more heat per unit of furnace volume.

Masses of incandescent brick have effected partial remedy, because they have assisted to transfer heat from periods of ample temperature to periods of insufficient temperature. Mixture of the gases to be burned with air, a sufficient temperature, and an unimpeded space for combustion to complete itself, appear to be the essentials. The first is neglected where the gases rise vertically from the grate, though the error can be subsequently rectified. The second can only be secured by keeping the burning gas from contact with heat absorbing surface for a sufficient time to enable combustion to become sufficiently complete. The third is what is neglected in all cases where heat-absorbing surface is brought too near the grate, and is exemplified in the cross tubes of the Lancashire boiler, the fire tubes of the locomotive when the brick arch is absent, and the water-tubes of all improperly set water-tube boilers.

Unless such conditions are fulfilled the smokeless combustion of bituminous coal cannot be economically and certainly carried out. With these conditions fulfilled, smokelessness is certain. Bituminous fuel has a higher calorific capacity than anthracite where the proportion of ash is alike, and it will give a calorific effect just in proportion to its composition, but on account of the heat absorption of its volatile half the grate or actual solid fire temperature may be less than half that given by anthracite, while the locus of heat production will be extended to the length of the flame. In fine, there is nothing in smoke prevention that justifies the frequent assertion of its impossibility, and it is lamentable that at this late hour engineers and teachers of engineers should stultify their teaching by practising the opposite from what they teach or are taught, in disregard of the obvious scientific principles that underlie the processes of combustion.

THE PROGRESS OF THE STEAM TURBINE.

By the Hon. C. A. Parsons.

(Abstract of Paper read before Section G.)

To-day I propose to review the progress and the present position of the steam turbine both for land and marine work, and to consider how far it has actually established its position as a rival of the reciprocating engine.

The compound turbine commenced to be used in this country in 1884 for driving dynamos; by 1890 about 360 such plants had been

set to work, in size from 4 H.P. to 120 H.P., the total aggregate at this date being 5,000 H.P.; by 1896, 600 turbo plants had been sold, the total aggregate at that date being 40,000 H.P., and the largest individual plant of 600 H.P.

At the present time 800 turbo plants have been sold, aggregating 200,000 H.P., the largest being of 3,000 H.P. On the Continent, Messrs. Brown, Boveri & Co., of Baden, Switzerland, took up the manufacture of compound turbines in 1900, and have sold 20 plants, with an aggregate of 29,000 H.P., the largest being of 5,000 H.P.

The British Westinghouse Company has lately contracted with the Metropolitan and District Railway Company for the supply of 10 turbo-alternators of 5,000 H.P., and several plants of moderate size have also been built by the Westinghouse Machine Company, at Pittsburg. The total aggregate of turbines at work and on order, of the compound parallel flow type, for generating electricity, in England and on the Continent and elsewhere, is now not far short of 300,000 H.P.

The economic results of the steam turbine for the generation of electricity have compared favourably with those of the reciprocating engine; the steam consumption is generally less, and the running costs, notably the upkeep, expenditure on oil and attendance, are also less. There is also generally a considerable saving in the first cost of the plant, the housing and foundations.

The lowest steam consumption so far recorded has been 17·3 lbs. per K.W.-hour, with a 1,000-KW. continuous current plant, one of several built for the Newcastle and District Electric Lighting Company; this figure corresponds to about 10·2 lbs. of steam per I.H.P.-hour. There seems to be no doubt that still lower steam consumptions per horse-power hour will be reached in turbines of large size working with superheated steam and a good vacuum.

Several turbine plants have been tested after being at work for a considerable time in order to ascertain if any increase of steam consumption occurred with age, and in all cases no observable increase could be detected.

The adoption of the steam turbine system of propulsion in vessels of large size, such as Atlantic liners, cruisers and battleships, will be attended with very considerable advantage, more so than in the case of smaller vessels, for the large turbines that would be suitable for such vessels would be cheaper to build, lighter in weight, and occupy less space in proportion to power. The design of such large turbines presents no difficulties beyond those that have already been successfully disposed of in the case of smaller vessels, and the greater size facilitates the introduction of important refinements for reducing the coal consumption to the greatest possible extent.

THE APPLICATION OF ELECTRIC POWER IN THE IRON AND STEEL INDUSTRIES.*

By D. SELBY-BIGGE (Newcastle-on-Tyne).

(*Continued from page* 521.)

Cost of Production.

The author has frequently been asked another very obvious and reasonable question, viz., what is the cost of production should we adopt an electric plant in our works? In answer to this, the author has drawn upon a number of cases of different kinds and in different parts of the country, showing the rate at which the works owner can generate his own electricity. These figures are taken from actual examples of every-day working, and are not in any way test figures taken for the purpose of this paper. Taking these figures as a basis, it is an easy matter for a works owner, once having ascertained the total horse-power which will be involved in the driving and lighting of the entire works, to see for himself at what expenditure per annum he can run his works upon the new system.

Cost of Electricity Delivered on Switchboard.

Test of 139½ *hours, November* 17*th to* 23*rd*, 1901, *Britannia Works.*

Mean current (amperes)	3,464
Mean pressure (volts)	125
Mean power (watts)	433,000
Mean electric horse-power	580·42
Board of Trade units	60,403
Weight of steam per B.T.U.	27·52 lbs.
Weight of coal per B.T.U.	3·04 lbs.

Cost per B.T.U.		Cost per week.
Coal 3·04 lbs. at 11s. 6d. per ton ...	0·187	£47 4 0
Water 27·52 lbs. at 3½d. per 1,000 gallons	0·00963	2 8 6
Stores	0·00995	2 10 0
Wages	0·06625	16 13 3
Repairs*	0·0159	4 0 0
Superintendence	0·01192	3 0 0
Net cost per B.T.U.	0·30065d.	£75 15 9

Interest and depreciation on £15,000 at 10 per cent. per annum ... ... 0·099d. per unit.

* Includes labour of keeping 184 arc lamps in repair.

* Paper read before the Iron and Steel Institute at Düsseldorf, September, 1902.

Cost per I.H.P. per Hour.

Coal 2·27 lbs. at 11s. 6d. per ton...	0·1395
Water 20·53 lbs. at 3½d. per 1,000 gallons ...	0·00718
Stores	0·0074
Wages	0·0494
Repairs	0·01185
Superintendence	0·0089
	0·22423d.

Mean I.H.P. at 75 per cent. efficiency, 773. Coal per I.H.P.-hr., 1·705 lbs. Water per I.H.P.-hr., 15·4 lbs.

The author is indebted to Messrs. Richardsons, Westgarth & Co., Limited, West Hartlepool, for the following information on the subject of the economy effected by the introduction of electric driving into their works. The following is a rough summary of the changes which have been effected:—

These works were formerly driven by about 13 small and uneconomical steam engines scattered about in different places, the maximum aggregate I.H.P. of which would approximately be, say, 300 to 400.

Steam for these engines was furnished by a battery of 12 boilers, and the coal consumption for the driving of the works was approximately 100 tons of coal per week.

Five years ago the driving arrangement of the works was remodelled by the substitution of electric motors for the various engines, a power house being built in a central position, and equipped with two boilers each 15 ft. by 10 ft., two dynamos, each of about 400 I.H.P., and one small machine of about 120 H.P.

The tools throughout the works are now giving an output of at least 30 per cent. in excess of what it used to be, and are using 50 to 60 tons of coal per week in the generating station boilers.

The above facts speak for themselves with regard to the economies which have been brought about by the introduction of electric driving into the works.

The machinery throughout was constructed by Brown, Boveri and Co., and is of the three-phase alternating current type.

The cost of renewal and repairs over the period during which the machinery has been running (five years) has been extremely small, certainly not 1 per cent. of the value of the installation.

The managing director of a large engine works informed the author that they are now running their works on 7½ tons of coal per day, and are employing 800 men. Their works consist of four distinct yards, all yards are driven from one central station, and in the old method a boiler would have to be placed in each department, or else long lines of wasteful steam pipe. Their cost of production, including interest and depreciation on capital, is 0·46 of a penny per unit.

At a shipyard on the north-east coast, using only 11 H.P., the cost of production of electricity has been found to be only 0·6 of a penny per electrical horse-power per hour, this figure including all charges, interest and depreciation.

At another shipyard on the north-east coast the substitution of electricity for steam driving shows a saving of 43½ per cent. The figures are as follows:—

Cost of Power per £ Wages Paid.

Coal and Gas.	Electricity.
May 2, 1893, to April 24, 1894.	April 30, 1900, to April 30, 1901.
Wages ... £64,885	Wages £126,700
Cost of power 2,337	Cost of power ... 2,578
=8·66d. per £ wages paid.	=4·88d. per £ wages paid.

Taking the case of another shipyard which was previously driven by gas engines, the author has received the following particulars:—"We have no hesitation in saying that we are getting at least 30 per cent. more power out of our machines since we adopted electric power instead of the gas engines we used before.

"As far as the cost per B.T. unit goes, we have lately had readings taken, and find that last year's works out at about 0·8 of a penny; this is taking into consideration the depreciation on our plant, interest on capital, repairs, and in fact everything which we can possibly put down against this account."

The average output would not exceed 250 to 300 H.P.

The author is indebted to the managing director of another large shipyard in the North of England for the following statement:—"Some years ago, just about the time when we first introduced electrically-driven machines, we put in new boilers in place of the old ones, and while it must be remembered that the new boilers are more efficient than the old ones, I would say in general terms that our coal consumption has been reduced by some 40 per cent., although the amount of machines driven electrically is now greater than those which were formerly driven by steam, and consequently the reduction may be even greater than the percentage I mention above."

In a letter the author has received from Colonel R. E. Crompton, he states:—"In our own works, which are on a somewhat extended scale, the substitution of electric driving for the old shafting system has approximately halved our bill for power; in fact, the whole of the driving of the works and tools for about 1,300 men is practically supplied by one 120-KW. set fully loaded, and it is only when we are testing that we have to run two sets of this size, whereas by the old system we should have had to run two 200-H.P. engines continuously."

Another very interesting case, which although not in full operation as yet, shows conclusively the enormous advantages to be derived by driving works from their own central power station

Motor Tests.

Designation of machine.	Work done. Maximum.	Work done. Average.	E.H.P. absorbed by motor with machine running light.	E.H.P. absorbed with load on.	Size of motor recommended, H.P.	Remarks.
Large plate edge planer.	35′ × 1″.	$\frac{7}{8}$″ or 1″ plate.	14·75	24·5	30	Cut ·05″ thick on 1″ plate 4′ long at time of test. This machine took 29·5 H.P. to reverse.
Small plate edge planer.	15′ × $\frac{3}{4}$″.	$\frac{5}{8}$″ to $\frac{3}{4}$″ plate.	6·33	20·1	25	Cutting $\frac{3}{4}$″ plate 22″ long. 21 H.P. to reverse.
Plate straightening rolls.	4′ 6″ × 4′ 6″ × 1½″.	10″ × ½″ to 15″ × $\frac{3}{4}$″.	4·5	6·1	...	10″ × ½″ plate.
				16·1	...	Plate 4′ square by 1 1/16″ thick.
				14	15	Same plate on slow speed. This machine took 19·1 E.H.P. to reverse.
Cold saw	16″ × 6″ girder	About 12″ × 6″ ...	1·45	2·6	7	Cutting 12″ × 3½″ × ½″ channel. Saw fitted with friction gear for feed, which prevents a heavy load.
Punch shears & angle cutter.	12″ shear, $\frac{7}{8}$″ plate	$\frac{3}{4}$″ hole, ½″ plate	3·85	6·0	10	½″ hole, ½″ plate. 25 to min.
	1 1/16″ hole, $\frac{7}{8}$″ plate			8·85	...	1 1/16″ hole, $\frac{3}{4}$″ plate. 20 to min.
				5·15	...	Shearing 10″ × ½″ plate.
				4·9	...	Cutting 3″ × 3″ × $\frac{5}{8}$″ angles.
Large ending machine	Knives 22½″ long	...	1·88	15·42	15	Ending 20″ × 7½″ girder, ½″ web, 1″ flange.
Straightener & angle cutter.	Angles and small bars.	...	1·53	11·55	10	Cutting 3½″ × 3½″ × ½″ angle (momentary load).
				6·15	...	Straightening 6″ × 6″ angle piece.
Shafting driving six radial drills.	1″ holes ...	$\frac{3}{4}$″	3·7	7·5	8	All six drills at work. $\frac{3}{4}$″ holes in girder steel.
Large straightener ...	20″ × 7½″ girders	12″ × 6″ girders	3·96	6·9	8	Straightening 20″ × 7½″ girder.
Milling-tool notching machine.	...	...	2·42	8·05 maximum load	8	4″ × ½″ notches in flanges of 8″ × 4″ girders.
	...			5·8 average load.	...	Two notches cut at once.
Joggling machine ...	1½″ plate ...	$\frac{3}{4}$″ plate ...	9·85	16	...	Joggling 1 1/16″ plate.
Scarphing winch ...	2 tons at 40 ft. per min.	...	5·65	12·1		
				10·75		
Shafting	Driving lathes, nibblers, planes, machines, &c.	Slotting machines, drills, milling, about 70 in all.	21 E.H.P.	40—48	50	No. 1 shaft drives about 70 machines.
			1st motor 23 E.H.P., 2nd motor 22 E.H.P.	40—50	50	No. 2 shaft drives about 40 machines on first motor.
			2nd motor 24 E.H.P.	42—50	50	No. 3 shaft drives about 25 machines, slots and planers.
Grindstones	...	...	20·5 E.H.P.	53—55	60	Seven grindstones varying from 5 to 10 ft. dia.; each has fast and loose belt, also one Tusca grinding machine on same shaft.
Cranes	...	...	Driving ropes doing no work, 23 E.H.P.	48	50	All rope-driven cranes. 2-30 ton cranes; 1-15 ton crane; 2-10 ton cranes; all cranes on nearly full load at once.
Cold rolls (locomotive work)	Plates 40′ × 4′ 6″ × 1½″.	1″ plates.	Driving countershafts and belts only, 5 E.H.P.	30	30	Straightening a plate 36′ × 4′ 6″ × 1¼″.
				7	...	Straightening a plate 9′ × 17″ × 1″. Machine is driven by cross and open belts, and has four top rolls and three under rolls.
Joiners' shop machines	...	...	Driving shafting, 5·5 E.H.P.	10	20	During a week this motor was not seen to rise above 10 H.P. When busy it absorbs about 17 to 18 E.H.P. It drives 12 tools, including two circular saws.
Vertical shipyard drills and countersinks.	1¼″ holes and 1¾″ countersinks.	...	Driving countershaft off which 2 per cent. drills are worked, 3·5 E.H.P.	7·5	7	1″ hole and 1½″ countersink; two machines doing 280 holes in 8 minutes.
Punch and shears ...	1¼″ holes in 1″.	Plate.	2·7 E.H.P.	6	12	¾″ holes, ⅝″ plate, 36 strokes per minute.
	Shearing 1″.	,,	...	15	...	Shearing ⅝″ plate 16 ft. per minute.
,, ,,	,,	,,	2·75 E.H.P.	3·5	12	⅝″ holes, ½″ plate, 34 strokes per minute.
				11	...	Shearing ½″ plate, 11 ft. per minute.
Mangle rolls ...	1½″ plates.	¾″ × ⅝″.	4·5 E.H.P.	13·5	15	Motor is a series motor, with a tramway controller; belt drives direct to machine, and motor is reversed when mangling. This arrangement has given most excellent results.
Wood-Working Tools.						
Hatch boring machine	1″ holes.	⅝″ holes.	2·05 E.H.P.	3	3·5	Boring ⅝″ hole, in hatch 22″ broad, in 2 minutes.
Wood planing machine	...	...	4·4 E.H.P.	8·8	8	Cutting ½″ off plank 10″ broad × 17′ long in 1·5 min.
Wood planing machine (heavy)	...	...	4·5 E.H.P.	16	16	⅛″ off plank 7″ broad × 13′ 6″ in 30 seconds.
32″ circular saw ...	...	...	0·9 E.H.P.	14·8	15	Cutting 3″ teak—hand-fed—14′ long in 20 seconds.
Heaviest class of shearing machinery	Steel tires of loco. wheels.	General scrap.	2 E.H.P.	29	30	Machine cut about 35 pieces 11″ × 1½″ section in 1 minute.
Punching machine ...	2″ dia. holes in 1½″ plates.	1¼″ holes in 1″.	3 E.H.P.	10·5	12	Punching 19 holes per minute 1⅞″ dia., through 1″ plate. Machine driven by belt.
Large shipyard rolls	26′ rolls to bend 1½″ plates.	½″ and ⅝″ plates.	8 E.H.P.	26	30	Bending plates 20′ × 4′ × ¾″ (load at reverse 26 E.H.P.). Rolls driven by cross and open belts.
18″ dock pump ...	...	...	...	74	70	Pump discharges about 500,000 gallons per hour.
5″ dock pump ...	...	...	...	11	10	Leakage pump.
Plate edge planer ...	⅝″, ½″, and ⅜″, plates.	Planing about 24′ per minute	5½ E.H.P.	⅜″ plates 10	20	This machine took 23 E.H.P. to reverse; motor has cross and open belts on special wide pulley, thus dispensing with the use of a counter-shaft.
Punch and shears ...	1¼″ × 1¼″.	1″ holes in ⅝″ plates.	3·5 E.H.P.	7·5	10	1″ hole, ⅝″ plate. 31 strokes per minute.

is that of Messrs. Head, Wrightson & Co., Limited, of Thornaby-on-Tees. In this case no fewer than 39 steam engines and 20 boilers are being replaced by two combined plants, with one as a standby, and by two boilers.

The whole plant is designed upon the most modern lines, and advantage has been taken of every known device to reduce the cost of production to the lowest possible limit. The actual working results of this installation should be available in the course of a few months' time.

In summarising the above cases, it is obvious that the greatest economy results in the substitution of electricity for steam in those cases where the units of power, both in engines and boilers, are the most sub-divided.

There are, however, enormous advantages to be derived, especially in the case of intermittently working machinery, where the load is of a very variable nature, and particularly so in all crane work, which plays such an important part in our engineering industries

Machinery Tests.—In his papers before the Iron and Steel Institute, Cleveland Engineers, and Manchester Society of Engineers, the author gave a short table of powers absorbed by various classes of machinery. This was necessarily, at the time of writing the papers, somewhat scanty and incomplete. He now therefore places at the disposal of the Institute an entirely new and complete schedule of tests, which have been carefully and accurately obtained by members of his staff during the past few months, and he trusts that engineers and managers of works may find these figures of some practical service and a guide to them in deciding upon the horse-power of motors to be adopted for the driving of various classes of machinery. The list will be found to embrace most of the tools usually found in engineering establishments.

(To be continued.)

TEUTONIC ELECTRICAL COMPANIES.

Side Lights on Count Posadowsky's Statement that Germany Occupies the First Position in the World!

"Germany stands at the head of the electro-technical industry in the matter of production. When you see in other countries how miserable, for instance, electric lighting is, we can say with pride: Germany's electro-technical industry is the first in the world. It would be heavily damaged by the introduction of a duty on copper. Our exports of manufactures and unwrought goods are 12½ times greater than our imports." This is not an extract from a modern Teutonic fairy tale, but it forms the concluding observations of Count Posadowsky in winding up a four hours' debate which took place on the consideration by the German Tariff Bill Commission of the clause proposing to allow raw copper to be imported free of duty as at the present time. That Count Posadowsky, who occupies the position of Secretary of State for Home Affairs, should have made such a statement, may cause considerable surprise both in England and the United States, because his official status must, or at all events should, have placed him in possession of information which is now a year old even in Germany, and which at that time revealed a situation of existing and impending financial disaster in the Teutonic electrical engineering industry. Since then the position of affairs has become worse, and the fact was already known when the Secretary of State delivered the speech in question early in August. If he had stated that Germany stands at the head, or is the first, in the matter of financially disastrous electrical undertakings, the description would have been more accurate. But this is quite immaterial now.

Count Posadowsky was under the necessity of saying something to secure the adoption of the free-of-duty raw copper clause. He was successful in carrying the clause, and his mis-statements and exaggerations having accomplished their object, are of little account at the present moment. Unfortunately, however, German investors and banking institutions do not share the optimism and patriotic glorification enjoyed by the Secretary of State, and they are to-day beginning to deplore more and more their attitude of having provided millions of pounds which have been irretrievably lost in the speculative ventures of promoting and other companies. We give below examples of three undertakings. Rumour says that there are more to follow, but this remains to be seen.

The Schuckert Company.—The annual assembly of the Schuckert Company at Nuremberg on August 27th produced a very large attendance of shareholders, but notwithstanding the tension with which the proceedings had been anticipated, little further light was thrown on the position of the undertaking, and its relations with the Continental Company for Electrical Enterprises, than that which is given in the company's report. Prior to reaching the order of the day, the directors submitted a statement, attributing the losses incurred during the past year to the branch establishments in Russia, England, and France, the water-power installations at Hafslund and Bergamo, the undertakings in Lonza and Jaice, the central stations worked by the company, and to its trust, the Continental Company, whose credit is guaranteed by the Schuckert Company. The discussion of the position of affairs extended over several hours, and upon Herr Wacker, formerly general director of the company, devolved the duty of replying to criticisms. He defended the policy of the company, and the formation of the Continental company and its practical amalgamation with the Schuckert Company. If the trust had not received the support of the parent-concern, the danger of liquidation would have arisen, but he remarked that negotiations were now proceeding with a Berlin banking syndicate with a view to a more easy realisation of some of the securities held by the Continental Company. It will be unnecessary to say anything further respecting the meeting, beyond mentioning that the report and accounts were eventually adopted by a large majority; and reference may now be made to the company's report for details concerning the disastrous results. The company, which has a share capital of £2,100,000, and issues of bonds to the extent of £1,595,000, gives the working results for the year 1901-02 in one set of figures, as in the case of certain other undertakings. It may interest others, besides those who speak of individual concerns possessing orders of the value of £10,000,000 at any one time, to learn that the total turnover of the Nuremberg company and its branches last year amounted to £2,450,000, as compared with £3,600,000 in 1900, £3,850,000 in 1899, £3,350,000 in 1898, and £2,350,000 in 1897. Other figures may be summarised as follow:—

Year.	Gross profits.	Net profits.	Dividend.
1897 ...	£355,279	£227,244	14
1898 ...	452,474	320,900	15
1899 ...	630,412	462,451	15
1900 ...	538,771	312,185	Nil.
1901 ...	193,936	—	Nil.

It will be seen that, although no dividend was paid for 1900, the table shows a net profit, as given in the company's accounts for that year, of £312,185. The proposal to make a distribution of 10 per cent. was abandoned at the general meeting a year ago, and the balance of profit was carried forward. The accounts for 1901-02, which, of course, include this balance, now reveal a total loss amounting to the enormous sum of £769,965. Among the losses may be mentioned £25,000 on the sale of the Jaice electricity and carbide works, £87,682 on two of the company's branches, £6,945 on central stations worked by the company, and heavy losses on the Mulhouse and Hafslund works incurred in conjunction with its trust (the Nuremberg Continental Company for Electrical Enterprises); £388,924 has been written off for depreciation of investments and syndicate business; and £450,000 has been set aside or written off for depreciation of materials and the fulfilment of guarantees undertaken by the company. To meet these losses there are only the gross profits and the balance brought forward from last year, the result being the heavy deficit already mentioned. The company's report states that in consequence of the lack of orders the number of workmen was reduced last summer, and the length of the working shift was curtailed in the winter. In the spring of this year, however, the normal hours were reverted to, and since Easter work has been generally resumed. The losses for the year are to be met by drawing upon the reserve fund, which thereby becomes reduced to £65,633. With regard to the negotiations with the Allgemeine Elektricitäts Gesellschaft respecting the establishment of a community of interests, the report remarks that these have not led to any result owing to the existing difficulties. An increase of 18 per cent. in the value of the orders received has taken place since the beginning of this year, and a slight improvement has now been noticed in prices. The company expresses the hope that by having written off so largely for depreciation, the undertaking has been placed on a basis which will render it free from any disadvantageous effects that may be caused by fluctuations of its investments in the future. As to the Continental Company, of which the Schuckert Company holds nine-tenths of the share capital, the directors of the latter state that its development has not fulfilled anticipations, and the balance-sheet shows a loss of about £60,000 for the past year.

The Schuckert Trust.—The Continental Company for Electrical Enterprises of Nuremberg—the Schuckert Trust, it may be well to repeat—has a share capital of £1,600,000, and a bond issue of £500,000, and is interested in various tramways and lighting and power stations in Spain, Italy, Austria, Germany and Russia. According to the company's report, the receipts from enterprises and investments, which declined from £187,903 in 1899 to £72,742 in 1900, increased to £108,851 last year. It was possible to realise some of the securities, although the profits obtained were less than those expected in normal times, and the cash thus procured allowed of a reduction in the bank credit being effected. The business results were also prejudiced by the suspension of Stock Exchange quotations of some of the securities held by the company. The report remarks that in a number of cases the progress of the company's undertakings has not fulfilled anticipations, although the results have generally improved. After meeting expenses and providing for depreciation of investments, payment of interest, bank charges, &c., the accounts show a debit balance of £59,918, which by absorbing the reserve fund reduces the deficit to £37,959. A few items from the accounts will be of interest. These are:—

Administrative expenses and taxes	£20,680
Bank and interest charges	71,144
Loan interest	20,000
Depreciation or loss on investments and syndicate business	41,840
Capital redemption and renewal charges ...	21,355

The figures are self-explanatory, and are noteworthy, especially the bank charges, of the financial methods of this particular company.

The Lahmeyer Company.—The annual meeting of the Lahmeyer Company, which was held on August 26th at Frankfort-on-the-Maine, did not attract a large attendance of shareholders, notwithstanding the unsatisfactory position as disclosed by the report and balance-sheet, and the proceedings were quiet and orderly throughout. Herr Salomon, the general director, who replied to the com-

ments of various shareholders, made a long speech, in the course of which he remarked that the six large firms which construct dynamos are at present only occupied to the extent of from 50 per cent. to 60 per cent. of their possible output, and the number of men employed is correspondingly less. The result was not only a diminution in the financial yield but also a more severe competition to obtain any single order. Endeavours had been put forth for years past to arrive at an understanding among the various firms, and they were advanced to a large extent by the good personal relations existing between the leaders of the companies individually; but an arrangement was not yet possible owing to the variety of interests and manufactures. The personal opinion of the general director was that an understanding must in the first place be arrived at by uniting the financial interests, and by this the speaker apparently referred to the question of fixing prices on a basis to which each company should strictly adhere. Herr Salomon proceeded to observe that a certain amount of the company's expenses originated in the preparation of schemes. In earlier years an attempt was made to combine the firms on this point, and five years ago the company succeeded in establishing an agreement with others whereby it was agreed that projects should no longer be prepared for towns and municipal authorities free of charge; but the arrangement only lasted for two months. A very large portion of the expenditure was due to the "sale propaganda," but an alteration was scarcely possible until the companies arrived at an understanding. The Lahmeyer Company did not belong to the cheapest of companies, and that rendered business difficult at the present moment. Passing over the depreciation of materials, the speaker next referred to the position of the German Company for Electrical Enterprises, which has acted as the trust for, and has now practically been absorbed by, the Lahmeyer Company by means of an interchange of shares and bonds. Taken as a whole, the undertakings of the German Company yielded a return of from 3½ per cent. to 4 per cent., although the sum of £300,000 was now required in order to complete the installations still in progress. A definite opinion as to the balance sheet of the German Company could not yet be arrived at, but its results were only influenced by those of the Lahmeyer Company. As far as the latter was concerned, the orders on hand at the present time were only 12 per cent. less than those at the corresponding period of last year, but Herr Salomon said that no conclusion could be drawn from this fact in regard to the probable complete year's results. The report and balance-sheet having been adopted, the proceedings were brought to a close.

As the report has not been referred to in these columns, it now deserves brief mention. It should first of all be stated that the company, which paid dividends of 8 per cent. in 1896-97, 10 per cent. in 1897, 11 per cent. in 1898 and 1899, and 10 per cent. in 1900, now has a share capital of £989,500 apart from a bond issue nearly approaching that amount. The report shows that the gross profits for 1901-02—all summarised under the heading of manufacturing, working, investments, interest and commission—reached £111,000, as compared with £215,600 in the previous year, but as the general expenditure amounted to £116,581, the gross profits are insufficient to meet this item alone. When, however, other items are taken into consideration, the position becomes more unsatisfactory. Thus after providing for ordinary depreciation and interest on the bonds, no less than £97,480 has had either to be written off for depreciation or set aside for doubtful business and guarantees, the final result being a deficit of £124,693 for the year, which is covered by drawing on the reserve fund. The report attributes the loss to the diminution in the manufacturing profits and the necessity for making large provisions for depreciation; the reduction in the gross profits is explained by the decline in the sales to the extent of from 10 per cent. to 12 per cent., the constant weakening of prices simultaneously with only a slight change in the cost of production, and the depreciation of materials in stock. If, however, the goods sold on account of third parties are taken into consideration, the total turnover is 25 per cent. less than in the preceding year.

With regard to the various branches, the experience of the Lahmeyer Company, in Russia, has been similar to that of other German companies which have found the purchasing capabilities in Russia to be limited, and the expenses double those incurred in other countries. As a consequence, the Moscow and Warsaw branches have been closed, whilst the Kieff establishment has to be maintained owing to the Kieff—Swiatoschin tramway belonging to the Lahmeyer Trust. The Italian Lahmeyer Company has yielded a return of 4 per cent., and the English Company is working favourably. It is true that the operations of the latter during the year ended March 31st last resulted in a loss, but this is due to the profits only being included in the current year's accounts. In this connection it is reported that the general expenses of the Lahmeyer Company comprise not only the head works, but also all the expenses of the foreign offices, which are otherwise considered as an independent company. It would be interesting to learn whether this assertion is correct.

MUNICIPAL TRADING.

It would be impossible to state the case against excessive municipalisation in a more convincing manner than was done by the Hon. R. P. Porter before the British Association meeting at Belfast last week. We have frequently had occasion to criticise the municipal operation of English electrical undertakings on a variety of grounds which need not be recapitulated here; and if, at times, we have appeared to be a little too sweeping in our condemnation, it is not because of any predilection on our part for any particular set of promoters or companies, but because we have felt that the matter was assuming very serious proportions, both from a national industrial, and from a ratepayer's standpoint. Our strongest criticisms, however, find the amplest possible support in the striking account which Mr. Porter gave of the history of the municipal movement in the United States about 50 years or more ago. We have looked through the columns of some of our socio-municipal contemporaries this week expecting to find that not a vestige of Mr. Porter remained after they had dealt with him, but the attention given to that gentleman's important utterances is of the scantiest kind. It amounts to this: "We have heard all this before," and "You are a partisan of company interests." This is the sort of argument that everyone who criticises the municipal movement is met with, and it is not worth wasting space over. Dust-throwing so as to confuse the American trusts with the limited liability companies of this country, and thereby mislead the public to the belief that electrical and other public promoters in England are hydra-headed monsters working wreck and ruin, is a very weak procedure to fall back upon. Can the municipal enthusiast quote a few English electric light and traction companies whose practical operations during the past few years rightly bring them into such a category? But to return to Mr. Porter, who is director of the U.S.A. Eleventh Census, let us see what he says about the past history of municipal trading in the States. Presumably this gentleman is in a position to verify his facts and figures, and judicial minds will accept what he says as to matters of fact, and form their own conclusions thereon. Mr. Porter is accused of being out of harmony with the present tendency in the U.S., but the facts upon which his subsequent remarks were apparently based are in themselves a sufficient contradiction of that assertion. Certainly we fancy that he will be found to be in harmony with the view which is being formed of the matter in responsible quarters in this country now that the eyes of the public are being opened to the real facts of municipal losses and mismanagement.

The fundamental idea of the American Republic is for its Government to interfere "as little as possible with individual effort and enterprise," and in this country it has been shown unmistakeably that the growth of municipalisation has meant the suppression of these very necessary qualities, not only in a financial, but also in an engineering and managerial sense. As few restrictions and obstacles as possible are placed in the way of large public undertakings there, and there has consequently been the freest play for personal initiative, but here after municipalisation has done its best (or worst), we are greeted by the local councillor with the taunt that if the contracts for electrical machinery go abroad, it is the English manufacturers' own fault. A municipal trading fever swept over the States in the forties and fifties of last century, "and ended in bankruptcy and ruin, not only of cities and towns, but of important States;" Americans were taught "the useful lesson that there was a limit to State and municipal credit," and this has had much to do with the subsequent hesitancy on the part of the U.S. to plunge into "*experimental* municipal industries."

It will interest English municipalities to learn that in America the period for repayment of local loans is much shorter than in England, extending generally to about 25 years. While this permits of the exercise of sufficient borrowing powers for legitimate needs, it is a safeguard against "a full swing of the fascinating arena of municipal trading." Mr. Porter continued:—"Partially because of the debt limitation, and partially because private enterprise has been allowed a freer headway in such undertakings as the supply of gas, electric lighting, tramways, and telephones, we find in the United States no city owning and operating its own tramways and street railways, probably less than half a dozen manufacturing gas, a very few engaged in supplying electric light, and, I think, not one engaged in the telephone business. American cities, however, are well supplied with all such utilities. . . . Our cities are well supplied with good quality of gas at prices generally regulated by the State Legislatures. In many cities competition has brought down the price below legal rate, and it has been found difficult, if not impossible, to put it up again. The few experiences we can point to in which cities have undertaken to supply their own gas have been melancholy failures. Some few of the smaller towns have undertaken municipal electric lighting; but where comparisons are possible the cost is found to be relatively higher. We have had no experience in municipal telephoning. Since the expiration of the original patents competition has not only greatly increased the efficiency and reduced the cost, but in some States where the laws have effectually regulated these monopolies, has established a service that would be difficult to excel."

We extract the following from later remarks by Mr. Porter:—"I venture to suggest that there is a danger when municipalities take up industrial enterprise that they do not always consider simply what is best for the public, but what will make a good showing in the annual budget. They are apt to be bitten by the desire to deal in large matters, whereas if they looked at the matter fairly and squarely they would see that their only hope of safety lay in keeping out of business with trust moneys, and looking sharply after those undertaking to manage semi-public businesses in their midst. This seems to me the real function of municipal administrators. The questions which, it seems to me, must be answered, are more far-reaching than these, and the principles involved much broader than the profit-and-loss account of a municipal ledger. First of all—and I put it before all fiscal considerations—what will be the effect of municipal trading on the excellent work which your English municipalities have taken up and conducted with such a large measure of success during the last 25 years? More than 20 years ago I was commissioned by one of our Government departments to visit England and study your methods of administrating

municipal affairs. The budgets of many of your cities were at that time carefully gone over, and I had no words except of praise for the conduct of affairs. Everything was being done to brighten and improve the life of the people—better sanitary arrangements, more parks and open spaces, additional supply of pure water, increased school accommodation, establishment of free libraries, encouragement of music in the parks, and other movements for the uplifting of the people and the maintenance of a high degree of municipal spirit. It was a programme that everyone could heartily endorse, so long as it was continued upon lines of equality, and all were fairly taxed for the benefit of the entire community. No one thought of making money out of these enterprises; no communities had then built around the sacred person of a town clerk a competitive force which was soon not only to antagonise existing railway companies—oftentimes the largest ratepayers of a district—but was to compel its own citizens to assume responsibility for loans to promote industrial undertakings which would compete with, and perhaps ultimately destroy, their own business. In short, the ennobling civic work in which all could join has, since the period I am speaking of, been changed, and municipalities have, in many instances descended to a form of competition which is not only unjust to the ratepayer, but which, when it assumes the shape of organised town clerks attempting to influence Parliamentary legislation, would be considered an illegal proceeding in the United States. The bitterness expended by these Parliamentary contests to prevent individual enterprise, and continue municipal monopolies in tramways, in gasworks, and electric lighting, and the disposition on the part of municipalities to secure these rights and hold them, dog-in-the-manager-like, against private companies anxious to invest and serve the public, have, in my opinion, done much to side-track public-spirited municipal work in England. It may lower the tone of your administration of local affairs from the high standard it should occupy by introducing too much of the commercial spirit. This reckless scattering of public funds is in strange contrast with the experience and economies deemed necessary for the successful promotion and development of private enterprise. When called to account, they seek to soothe the troubled ratepayer by dividing the rapidly-increasing municipal debt into 'productive' and 'unproductive.' The increased tax rate, they promise, is soon to be reduced by the 'profits of the new enterprises.' It is a game that cannot be played to the end to the satisfaction of both sides. The profits, too, often are chimerical, and disappear in higher cost of installation and of operation, which more than offsets the somewhat cheaper cost of capital when the public credit is pledged for its repayment. Then there are the heavy expenses resulting from changes in methods, involving the sacrifice of entire plants, that modern industry must continually face, and which sometimes results in heavy sacrifice of capital. There remains but one place for the losses—and all business ventures are liable to losses—namely, the rates. The present local indebtedness of the United Kingdom is well over £300,000,000, an amount equivalent to double the same class of indebtedness in the United States. Between 1879 and 1898 this indebtedness has grown £150,000,000. The piling up of local indebtedness, we should remember, tends to escape the purview and control of Parliament in a way in which the national debt does not, and the danger is thereby increased. This may not cause any alarm; and I even notice an endeavour on the part of representatives of some municipalities to induce Parliament to extend the period of repayment of certain classes of loans to 100 years. Here is unloading obligations on posterity with a vengeance! In the United Kingdom the total increase in the ratable value of the country in 25 years has been less than 30 per cent., while its local indebtedness has trebled. The American returns for the last 10 years have not yet been published; but I think it may safely be assumed that the reverse of this proposition is true—namely, that our local indebtedness has increased in 30 years 36 per cent., and the value of taxable property has trebled. These figures are not introduced for the purpose of indicating that we are wise and you are unwise, but for the purpose of showing the effect of placing a limitation on this class of debt. In spite of the activity of municipalities, in England private enterprise has not been entirely beaten in the race; while I observe in certain quarters it holds its own admirably in competition with tax exploited industry. Even the capital invested in private company electrical undertakings is increasing, and this in spite of almost insurmountable obstacles. It is a case for gradual readjustment, not violent changes. With the facts fully understood, the people will by degrees curtail these unwise and dangerous economic experiments, and bring your cities back to the sphere of work which is strictly their own. The broadest objections to municipal trading, as carried on in England, would seem to be six in number. The injurious effect upon the work which is strictly within the municipal sphere of operation. The fact that in giving the required attention to trading operations, the 'unproductive' work is almost certain to be neglected. The tendency to discourage improvement or development. The engendering of ill-feeling, which is sure to arise when the taxpayer finds himself obliged to help defray the cost of competing with himself, and which ends in quenching civic pride. The difficulty in adjusting the burden of a trading undertaking on the right shoulders, and such an equitable regulation of the charge as will not put a burden on those who derive no benefit. In conclusion, permit me to say that I am a firm believer in the municipal spirit of the age, and an ardent supporter of all its higher aims. These few words of warning are therefore offered, because I believe municipal trading propensities, if not limited, will neutralise and destroy much of the good already accomplished by conscientious municipal workers in their proper sphere, both in England and in the United States."

OUR COMMERCIAL SUPREMACY.

In *Cassier's Magazine* for this month there is an article on "Electric Light and Power in the Korea," contributed by Mr. R. A. McLellan, chief engineer of the Seoul Electric Company, Seoul, Korea.

Apart from one or two little errors concerning the Koreans, which in no way affect the technical value of the article, we are able to state, from personal knowledge, that it is a plain, intelligent, and honest statement of facts which reflect no credit on our representatives in Korea. But it is reliable testimony as to what may be done even in so stagnant a country as "the land of the morning calm" by honest enterprise backed up and encouraged by efficient consular organisation.

The writer is an Englishman with wide and long experience in engineering undertakings in the "Far East," imbued with all the natural prejudices of his nation, and consequently feeling all the more acutely an Englishman's disappointment at seeing a field which should be British, occupied, without the faintest sign of opposition on our part, by our American cousins.

Messrs. Colbran & Bostwick are Western Americans. They were sub-contractors on the pioneer railway now running successfully under Japanese management between Seoul and Chemulpo, the bridges, permanent way, rolling stock and locomotives of which are all American.

They not only control the electric light and power in Seoul, the capital of Korea, but they hold the concession for long-distance and local telephony for the whole empire, and they have secured the contract for future extensions of the electrical tramway system, the first section of a fairly large system of waterworks for the capital. They are also, with some truth, credited with the establishment of an American-Korean bank, the first attempt to initiate some reform into Korean finance, in which they are assisted by the establishment of a small steam coinage factory, which, it is hoped by the astute promoters, will some day develop strength enough to be a reliable foundation for a Korean Imperial mint and national banking system. It may be argued by those who know Korea that such institutions are at present purely visionary, but there is no knowing when they may become positively practical, and in view of present relations between Great Britain, Japan and Korea, there can be no possible doubt of the important value of the wedge which will open up the country, the thin end of which is now being carefully inserted by our American cousins.

The article referred to is a fair and straightforward description of the electric light and power plant. Every foreigner concerned in its working and management is American. The service is far better, and more reliable than many others the writer has seen in countries where the conditions are far easier to meet, and the trained native staff of motormen and conductors are, for cool-headedness, quickness and intelligence, most certainly not surpassed by their *confrères* in New York or any other big American city. The native Korean employé has been induced to add to these qualifications, those of politeness and forbearance, which his American brother might copy with great advantage to all concerned. By some mysterious influence, Messrs. Colbran and Bostwick have induced their outdoor staff to sacrifice the highly-cherished "top-knot," to don American uniforms, and to assume that smart and lively conduct and punctuality which is so much at variance with the innate grave and time-wasting characteristic of the true Korean. In fine, there is nothing left undone by Messrs. Colbran and Bostwick which might tend in the least degree to prove to the Korean that the American is his best friend, and might thus strengthen the vigorous hold which they are gradually getting on the future of Korean advance and development.

These gentlemen are not only backed by enterprising capitalists in San Francisco, but their designs are pushed on to success by the vigorous action of the American Consuls in Korea, as well as by the strenuous support of the American Legations of Seoul and Tokio, whose influence also secures the aid of Japanese, who are all powerful in Korea.

These American installations are by no means of a make-shift or temporary nature, but are well constructed, with full provision for future extension, and are there to stay.

So much for American enterprise in a country which is absolutely virgin soil to foreign civilisation, and in which she has neither directly nor indirectly any claim to preference.

England, on the contrary, in virtue of her greatly preponderating political influence, as well as her older commercial position in the "Far East," should, under proper consular influences, not only claim but hold absolutely the leading position in Korea.

The American has achieved the well-merited success of his energy and daring under proper official support. The share of Great Britain in the commercial development of Korea does not amount to the value of a single rail, nor even to a fishplate or a ½ in. iron bolt.

There is not much solace to be found in the fact that the expenditure of our Government in the Far East for imposing Legation and Consular buildings and still more imposing gold-laced Consular officials, amounts to at least 100 times as much annually as that of the United States. And there is still less solace in the fact that for all purposes of commercial expansion, this enormous outlay is a dead loss to the country, serving only to accentuate the utter uselessness of the British consular official abroad when the interests of his nation in trade or commerce is concerned.

The crying demand of our countrymen abroad is for Consuls who will make the interests of the British merchant their own. Maintenance of dignified inaccessibility, and an assumption of supercilious patronage of the national who ventures to apply for aid in legitimate enterprise, may, perhaps, be

more or less indispensable to a diplomatic career, but it is not this for which the British merchant is pining, and on account of which he is being pushed to the rear by his competitors. What he wants to secure him an equal chance for business with the rest of the world are broad-minded and energetic Consuls, and from the facts we have detailed above, it would seem as if there existed sound cause for recommending a great deal of American method in the constitution and working of a new commercial Consular service, whose motto should be "English Trade and Commerce, First, Last, and all the Time."

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

19,635. "Improvements in alternating current meters." A. May. September 8th.

19,672. "Improvements in electrical switches." H. Nunns. September 9th.

19,688. "Improvements in the carbon feeding and arching mechanism of electric arc lamps." Veritys, Limited, and W. R. Ridings. September 9th.

19,689. "Improvements in the carbon feeding mechanism of electric arc lamps." Veritys, Limited, and W. R. Ridings. September 9th.

19,713. "Improvements in the composition of electrolytes for the formation of accumulator plates." E. Sandhagen and J. Lurgen. September 9th. (Complete.)

19,774. "Improvements in and connected with the production of caustic soda and sodium hypochlorite by electrolysis." F. Ferrand. September 10th.

19,838. "An improved trolley-wire clamp of the kind known as 'come along' clamps." J. Wilkinson. September 11th.

19,839. "Improvements in mechanical shunting points used in overhead trolley wire for electric tramways." H. Breckenell, E. M. Munro and H. I. Rogers. September 11th.

19,849. "An improved automatic suspension and electrical contact appliance for apparatus requiring to be raised and lowered." J. Stevenson, Jun. September 11th.

19,854. "A guard wire for preventing tramway trolley wires from falling to earth when broken." S. Simpson. September 11th.

19,880. "Improved primary battery." W. Clapham and A. Clapham. September 11th.

19,891. "Improvements in electrical contrivances for communicating with passing trains." E. W. Clover. (E. C. Buck and H. E. A. Thatcher, Transvaal.) September 11th.

19,901. "Improved apparatus for converting variations to the intensity of an electric current into variations in the intensity of light." C. Hulsmeyer. September 11th. (Complete.)

19,967. "An improvement in an electro deposit of zinc." W. A. Thomas and J. E. Green. September 12th.

19,985. "Improvements in electricity meters." The British Thomson-Houston Company, Limited. September 12th.

19,991. "Improvements in and relating to alternating current electric machines." J. Mannheim. September 12th.

19,999. "Improvements in secondary battery elements and in the process of producing same." L. Fielder and G. Puchmuller. September 12th.

20,003. "Improvements in or relating to electric arc lamps." A. J. Boult. (A. Kunze, Germany.) September 12th. (Complete.)

20,024. "Improvements in trolley-wire holders for electric tramways and railways." P. Redford. September 13th.

20,025. "An improved adjustable bracket for gas, oil, electric, candle and other lamps or lights." R. W. Young. September 13th.

20,054. "Improvements in junction frogs and trolley heads for use on the overhead system of electric tramcars." D. B. Foster. September 13th.

20,074. "Improvements in electric arc lamps." L. Wirtz and T. Hamilton-Adams. September 13th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

13,401. "An improved electrical converting transformer." C. D. Abel. (Communicated.) Dated July 25th, 1900. Relates to converting alternating, particularly polyphase, currents into continuous and *vice versa*. A section of one form of apparatus is described. It comprises a fixed transformer, a collecting commutator and brushes rotated by a motor. The core of the transformer comprises a toothed ring with an outer ring formed of laminated segments. In each slot are fitted the coils, each having four windings. These are the primary winding, secondary and two compensating windings. The compensating windings have a different number of turns in each slot, the numbers being determined for particular cases by formulæ given in the specification. They are also connected to the motor circuits. In some cases the secondary coil is replaced by two coils wound in different directions and suitably connected. The rotary brushes are preferably carbon blocks sliding in holders; pneumatic tubes hold them in position, good contact being maintained by the centrifugal action. 3 claims.

13,415. "Improvements in the manufacture of electric insulators." C. A. Lopez. Dated July 25th, 1900. Insulators and the insulating portions of cut-outs, switchboards, commutators, &c., are formed of celluloid moulded by heat and pressure to the required form. The articles are cooled under pressure. 2 claims.

13,472. "Improvements in telegraphic transmitting, receiving and translating arrangements." A. Muirhead. Dated July 26th, 1900. Relates to the arrangement of apparatus in automatic telegraphy for transmitting a message to a cable, retransmitting from one section of a cable to the next, and receiving a message in the form of a perforated strip capable of use for retransmission. 7 claims.

13,482. "Improvements in collectors, conductors and conduits for electric traction." E. Bede. Dated July 26th, 1900. Relates to electric railways and tramways on a conduit system. The conductors consist of metal strips enclosed in a rubber sheath slit underneath or at the side to admit a disc mounted vertically or horizontally on the shank of the collector. The collector may be pressed upwardly by a spring bearing on a block which slides on the rail. The sheath is partly enclosed in an outer sheath of still insulated material secured on the inside of the guard rail, which forms one side of the conduit. The conductor and its protection may be made in lengths, which are connected electrically in place of insulated blocks pressed into contact with the conductor by caps on the plates which fish the rail. 2 claims.

13,518. "Improvements in or relating to overhead trolley wires or conductors for electric traction overhead electric cables or the like." R. Hacking. Dated July 27th, 1900. Relates to safety appliances for cutting out broken sections of overhead electric conductors, trolley wires, guard wires, telephone wires, &c. Levers are pivoted on brackets on the supports of a conductor, to which they are electrically connected. A link or wire also connects the lever to the conductor at a suitable distance. When the conductor breaks the levers come into contact with the bracket, or with contacts on the bracket, or on the insulator, or with a loop suspended from the span or supporting wires, such parts being connected to the return or to earth, so that the fuse may be blown. 5 claims.

13,533. "Improvements relating to electric motor road vehicles." E. Braulietta. Dated July 27th, 1900. Relates to electrically-propelled vehicles, and comprises a form of body and certain improvements in the motor apparatus and in the brake speeding mechanism. 5 claims.

13,538. "Improvements in or connected with current arresters." J. G. Lorrain. (P. C. Burns.) Dated July 27th, 1900. Arresters for sudden or continued excess currents liable to produce damage are constructed with one or more goose-necked springs connected to the lines. The springs grip, by means of fingers, the heads of rods. The rods have metal caps at each end, and have central portions formed of material such as hard rubber, which becomes pliable by heat. The central portion is surrounded by a helix of German silver wire. In bending, the rod is released from its socket, and the spring makes contact with the earth frame. The upright portion of the frame is attached to one side of each of two ordinary lightning arresters, the other sides of which are connected by springs to the line contacts. A glass protective shade is placed over the apparatus. 5 claims.

13,539. "Improvements in or connected with current arresters and alarms." J. G. Lorrain. (P. C. Burns.) Dated July 27th, 1900. Current arresters, for which the circuit is broken by the heating effect due to an excess of current, such as described in Specification No. 13,538, A.D. 1900, are provided with additional contacts by which an open circuit alarm is closed when the guarded circuit is open. 3 claims.

13,642. "Improvements in the production of amines from the corresponding azo compounds." G. W. Johnson. (C. T. Boehringer & Sohne.) Dated July 27th, 1900. Azo compounds are reduced to the corresponding amines by electrolysis. The azo compound is dissolved in hydrochloric acid, and is placed in the cathode compartment of the cell. The cathode employed is made of tin or of an indifferent material, and a tin salt, or tin in the form of powder, is added. The temperature of the cell is maintained at about 60° C., and the current density employed is about 800 amperes per square metre. An example is given in which p-amidoazobenzene is reduced to p-phenylenediamine and aniline. The p-phenylenediamine is precipitated by passing hydrochloric acid gas into the electrolysed solution. In another example amiso-B-napthol is obtained by reduction of orange II. 1 claim.

13,643. "Improvements in the reduction of nitro compounds to the corresponding amines." G. W. Johnson. (C. T. Boehringer & Sohne.) Dated July 27th, 1900. Nitro compounds are reduced to the corresponding amines electrolytically. The nitro compounds mixed with hydrochloric acid is placed in the cathode compartment of the cell, which contains also a platinum or other indifferent cathode, and finely divided copper, iron, chromium, lead, or mercury, or a salt of one of the metals. When the reduction has been effected, either the metal is found to have been regenerated, or a metallic ion of low valency has been produced, according to the electrolytic solution pressure of the metal. Examples are given in which nitro-benzene, which is kept cool, and is rapidly stirred during process, is reduced to aniline by a current having a density of 1,900 amperes per square metre, in presence of cuprous chloride and copper powder respectively, copper being left in both cases. 1 claim.

13,673. "Improvements in apparatus for electrically lighting railway trains." E. T. Parker. Dated July 28th, 1900. In electrically lighting railway trains a dynamo is driven from an axle and a controller is arranged to regulate the field magnet circuit in accordance with varying speeds of the train. 10 claims.

13,613. "Improvements in and connected with time checks." J. Smith. Dated July 30th, 1900. The operation of an electric switch for lights sends currents through two electro-magnets which cause fingers to prick a time recording cord. The switch may take the form of a cane, which applies or releases a stop for one of the pockets of a billiard table. 2 claims.

13,639. "An improved electric motor." A. G. Bloxam. (Soc. Ch. Milde Fils et Cie, France.) Dated July 30th, 1900. An electric motor for vehicles has two armatures keyed on separate shafts in line with each other, each driving a wheel of the vehicle. The field magnet consists of four steel bars, each of which is wound with a shunt coil and a series coil and carries two pole-pieces. Of the eight exciting coils four are disposed on either side of a central bearing, and the arrangement is such that a shunt coil faces and has on either side of it a series coil, while diametrically opposite to it is another coil. The end bearings are carried by brackets and the central bearing by rods. 1 claim.

13,653. "Improvements in the process for purifying or removing impurities from iron or steel while in a molten state and apparatus therefor." A. G. Greenway. Dated July 30th, 1900. Phosphorus and other impurities are eliminated from iron or steel by means of an electric current passing through the molten metal. The process may be effected in a cupola or converter, or in a reverberatory or like furnace having regenerators and provided with electrodes, which may be embedded in the opposite walls of the furnace. Or one of the electrodes may be embedded in the basic lining of the furnace while the other may consist of metal, such as platinum, chromium, or iron coated with a basic mixture of tar, graphite, lime or magnesia, and suspended in the mast of the molten metal. 2 claims.

13,679. "Improvements in holders for electrolytic incandescent lamps." B. M. Drake, E. G. Sheppard. Dated July 31st, 1900. A filament and a heater not enclosed in an exhausted bulb, are carried by a support which is separated by an air space from a cap to keep it cool. 2 claims.

13,693. "Process of and apparatus for duplicating phonograph records." T. A. Edison. Dated July 31st, 1900. Relates to methods of obtaining duplicates of phonograph records. 9 claims.

13,720. "Improvements in methods of operating dynamo-electric machines." British Thomson-Houston Company. (E. J. Berg, U.S.A.) Dated July 31st, 1900. The angular position of the rotating member of a synchronous dynamo-electric machine is adjusted by causing the member to slip until the desired angular position is reached, and then checking any further slip. The required slip may be brought about by a number of reversals of the direction of the current through the field windings. 5 claims.

13,721. "Improvement in systems of electric motor control." British Thomson-Houston Company. (C. L. Perry, U.S.A.) Dated July 31st, 1900. Relates to a motor control system for electrically-driven vehicles, &c., in which the controller comprises a number of separately actuated contacts, with actuating coils in connection with a master controller, the main object being to enable the several actuating coils to be efficiently operated at full line potential, the actuating coils are so arranged that in certain positions of the controller, a predetermined number of them may be connected in series across the mains, and are so proportioned that, when thus connected, they will take only the requisite amount of current; in the other positions of the controller, when a smaller number of contacts are to be actuated, the corresponding number of actuating coils is connected in circuit with a sufficient resistance to limit the current to that which would flow when the several coils are connected in series. 9 claims.

13,722. "Improvements in contact devices, chiefly designed for use in connection with electrical counting or recording devices." A. W. Staveley and I. H. Parsons. Dated July 31st, 1900. Relates to means for indicating at a distance electrically water and other liquid levels: counting apparatus. 8 claims.

13,761. "A new or improved automatic device for the safe operation of electric conductors, with or without guard wires." C. C. Orille and E. v. Schultz. Dated July 31st, 1900. Relates to a cut-out device for use in connection with overhead conductors with or without guard wire. The cut-out is designed to operate in case of breakage of the conductor or guard wires, or in case of short-circuiting due to telegraph, &c., wires, or in case of excessive currents. A magnetic cut-out is fitted in the main circuit, and has two windings, one for overload in series with the circuit, and the other a fine wire connected to an electro-magnetic controller. 4 claims.